UNIVERSITY OF CAPE COAST

TRADE OPENNESS, EXCHANGE RATE FLUCTUATIONS AND MANUFACTURING OUTPUT IN SUB-SAHARAN AFRICA

BY

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DECLARATION

Candidate's Declaration

I hereby declare that this thesis is a result of my original work and no part of it has been presented for another degree in this University or elsewhere.

Candidate's Signature: ……. Date: ……...

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Supervisors' Declaration

We hereby declare that the preparation and presentation of this thesis were supervised in accordance with the guidelines laid down by the University of Cape Coast for thesis supervision.

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ABSTRACT

Many industrialized economies in the world achieved higher economic growth through the industrialization of their manufacturing sector. However, in Sub-Saharan Africa, the development of the manufacturing sector appears to be in decline. In the quest to increase the economic growth of these developing countries, varieties of trade policies and exchange rate policies have been introduced. These policies were subsequently introduced in Sub-Saharan Africa (SSA) as a means of boosting economic growth and development. The importance of Trade Openness and exchange rate policies in developing countries necessitated the need to study the effect of Trade Openness and exchange rate fluctuations on the manufacturing output of SSA. The study also focuses on the role of electricity as an intermediating factor to Trade Openness, threshold effect, and heterogeneity across groupings. Using the principal component analysis to generate Trade Openness Index and other determinants from 2004 to 2017, (sourced from WDI and World bank doing business indicators), the study employed fixed and random effect estimation techniques in the analysis. The study revealed that less Trade Openness has a negative effect on manufacturing output in SSA. Exchange rate fluctuations have a positive effect on manufacturing. Therefore, it is recommended that the reduction of the trade openness index should be encouraged. Also, exchange rate stabilization policies should be encouraged to promote a good business environment.

KEYWORDS

Exchange Rate Fluctuations

Fixed and Random Effect

Manufacturing Output

Principal Component Analysis

Trade Openness

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DEDICATION

To my beloved mother and siblings.

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LIST OF ABBREVIATIONS

ADF	Augmented Dicky-Fuller
AFCFTA	African Continental Free Trade Area
ARDL	Auto-Regression Distributed Lag
AU	African Union
BOP	Balance of Payment
BRICS	Brazil Russia India China South-Africa
CUSUM	Cumulative Sum
CUSUMSQ	Cumulative Sum of Square
ECM	Error Correction Model
ECOWAS	Economic Community of West African States
ELC	Electricity
EXCFLU	Exchange Rate Fluctuations
FDI	Foreign Direct Investment
FE	Fixed Effect
GCF	Gross Fixed Capital Formation
GDP	Gross Domestic Product
GLS	Generalized Least Square
GMM	Generalized Method of Moment

IMF	International Monetary fund
INF	Inflation Rate
INTRAT	Interest Rate
KMO	Kaiser-Meyer-Olkin
LM	Lagrange Multiplier
LSDV	Least Square Dummy Variable
MFP	Manufacturing Output
MoTI	Ministry of Trade and Industry
MOOC	Massive Online Course
MSE	Mean Square Errors
OECD	Organization for Economic Co-operation Development
OLS	Ordinary Least Squared
PCA	Principal Component Analysis
PP	Phillip-Perron
RE	Random Effect
SADC	Southern African Development Community
SDGs	Sustainable Development Goals
SEZs	Special Economic Zones
SSA	Sub-Saharan Africa

SSE	Sum of Squared Errors
TDOP	Trade Openness
UECM	Unrestricted Error Correction Model
UN	United Nations
USD	United States Dollar
VALCO	Volta Aluminum Company
VIF	Variance Inflation Factor
WDI	World Development Indicators
WTO	World Trade Organization

CHAPTER ONE

INTRODUCTION

Background of the Study

Generally, country development is largely dependent on its industrialization policies and major structural changes (Sign, 2018). A major feature of developed economies is their massive industrial development, for example, the manufacturing industry has been one of the leading contributing factors to the economic growth of Japan, the USA, and other Asian countries. The manufacturing sector is always seen to be the engine for structural change in many economies and the need for sustained growth (Sign, 2018). At the time African countries gained their independence, most African governments pursued industrialization policies such as import substitution industrialization in the manufacturing sector, to reduce economic dependence on their colonial masters (Ackah, Charles, Charles Adjasi, and Turkson, 2014). Industrialization in sub-Saharan Africa was meant for industrial growth and diversification which were largely achieved in the 1960s. However, the sustained growth in the manufacturing sector became a problem in the 1980s. This was caused by inappropriate government policies and programs such as overvalued exchange rates, trade protectionisms hence the sub-Saharan African manufacturing industry has been on a constant decline, (Rodrik, 2014).

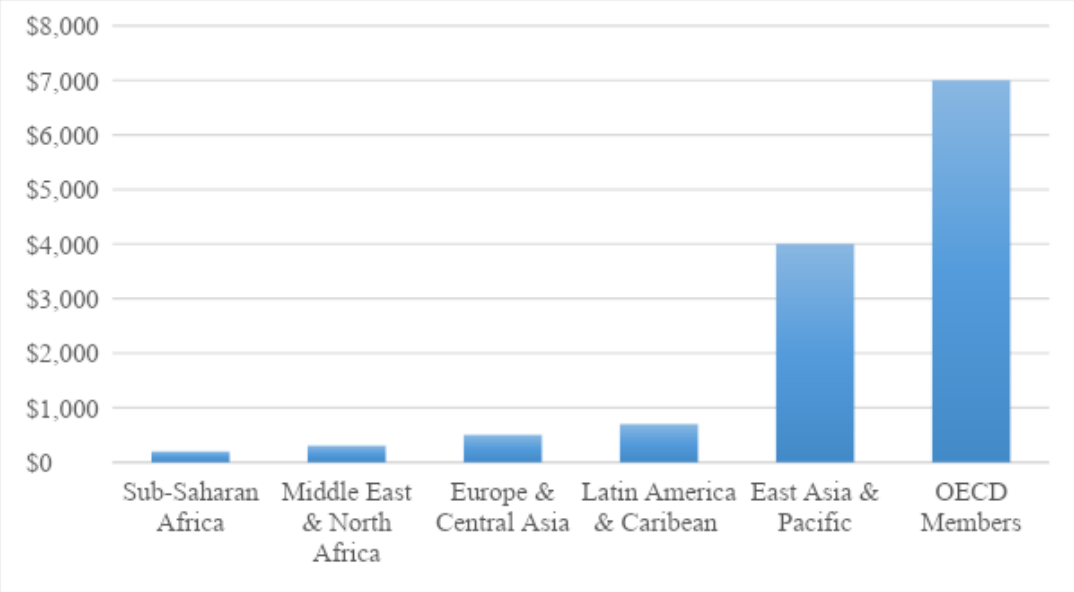

Figure1. Regional comparison of manufacturing output, 2017
Source: Sign (2018)

From Figure 1, countries with the Organization for Economic Co-operation and Development (OECD) have the highest manufacturing output of about US $7000 billion, while SSA has the least manufacturing output of about US $300 billion. The differences in manufacturing output among these regions may be as a result of technological progress and historical issues. Most sub-Saharan African countries lack the technology and technical know-how for the manufacturing industry to thrive. Also, most of the SSA economies were colonized. These economies are in their young stages of growth and development which may account for the low manufacturing output in the region.

From Figure 2, nations with a higher share of manufacturing output to GDP are South Africa, Egypt, and Nigeria of about 20%, 18%, 17% which translates into raw figures like the US $41 billion, US $39 billion, US $33billion respectively.

Zambia and Ghana have the least manufacturing output contribution to GDP below 5%. What could be the possible cause of these differences?

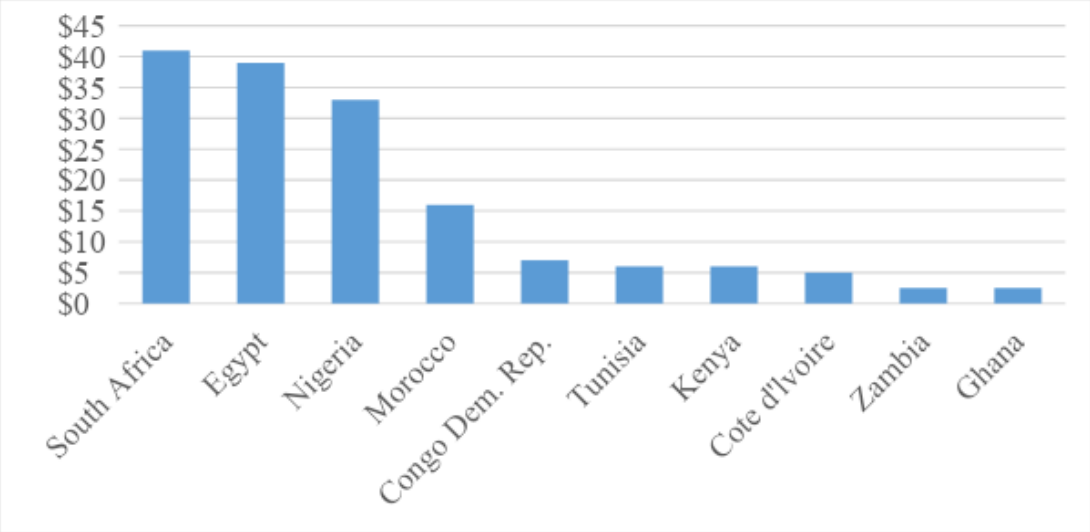

Figure 2. Manufacturing output for top producers in Africa (in billion), 2017
Source: Sign (2018)

The issues in SSA manufacturing industries are different: the high cost of production such as the high cost of transportation, the inability of some factories in landlocked countries to have access to the seaport, lack of good roads, interrupting power, low demand for locally manufactured products, etc.

Currently, SSA has the least power generation capacity globally. The region is experiencing an acute shortage in electricity production such that about 630 million people approximately are living without reliable access to electricity. Businesses and firms also do not have access to frequent electricity power supply (Avila, Carvallo, Shaw, & Kammen, 2017). For example; from 2014 to 2016, Ghana experienced frequent power outages which led to the closedown of some manufacturing firms. In Ghana, a number of manufacturing firms could not afford the high cost of using alternative sources of power (plants, generators) and this has

discouraged them from doing business in Ghana (Abeberese, Ackah, & Asuming, 2017). Also, the cost of doing business in SSA has become so high in terms of the bureaucratic nature and high level of taxes. There is also a very high level of corruption and these have substantially affected the manufacturing industry in SSA (N'da, K. C. 2012). Besides, non-availability or low availability of inputs such as raw materials, limited machinery, and equipment have been contributing to the low performance of the SSA manufacturing industry. The manufacturing firms in SSA have to import most of these raw materials and machines. Even if there exist raw materials in SSA, the arguments are that factories would still have to import packaging materials to package the finished products.

Moreover, the low patronage of African-made goods and the limited nature of markets for the manufactured products as a result of most households in SSA having low incomes and low consumption patterns does not encourage manufacturing firms to produce. Also, the manufacturing sector is shifting from manual operations to automated and machine sensors hence people who lack such skills become unemployed while manufacturing firms that cannot adapt to these technologies end up with the high and unsustainable cost of production (Dinh, Palmade, Chandra, & Cossar, 2012). These trends have posed a big challenge to the growth of the SSA manufacturing industry. Meanwhile, not denying the fact that the above mentioned could be possible factors restricting the growth of the manufacturing industry in the region, there is the need to consider the open macroeconomic factors because of their interactions with the rest of the world. This study will focus on trade openness and exchange rate fluctuations which have a

direct link with the manufacturing industry in terms of the global economy. In recent times, SSA leaders have worked harder to reduce the cost of doing business. Currently, some countries in SSA such as Nigeria, South Africa, Tanzania, Kenya can count on the stable power supply (Trotter, McManus, & Maconachie, 2017), improved infrastructure, and low level of tax regulation by giving some manufacturing firms tax-free. SSA countries are now showing good grounds for the growth of the manufacturing industry in the region.

The contribution of the SSA manufacturing industry to GDP has remained constant since the 1970s, on average 10%, and has not changed despite efforts being made by the SSA governments to boost the manufacturing industry in the region (Rodrik, 2014). However, at the 28th Africa Industrialization Day held by the United Nations in 2018, the Chairman of the Massive Online Course (MOOC) lectures, Paul Maselli indicated that Africa has deindustrialized. There are absolute deindustrialization and relative deindustrialization. Absolute deindustrialization is a moving out of labor from the manufacturing sector into other sectors, while relative deindustrialization is the decline in the share of GDP. Deindustrialization is a result of the bad business environment and government policies (Grabowski, 2015). The reason has been that the African share of the world manufacturing output is smaller today as compared to the 1980s manufacturing output and still the manufacturing output is likely to decline further (Grabowski, 2015). There is therefore the need for Africa to rethink adopting policies that could lead to structural change. The force behind the structural change from history is the manufacturing industry (John, 2016).

Moreover, the 2018 African Industrialization Day, organized by the Department of Trade and Industry of African Union Commission and United Nations Industrial Development Organization (UNIDO) was geared towards promoting the manufacturing industry and structural change in Africa. Furthermore, the African Union Agenda 2063 Industrialization of Africa and Continental Free Trade (Mohammed, 2018) was planned towards promoting the manufacturing industry in Africa. This means that governments and policymakers are planning and taking the necessary steps to industrialize Africa. The question is, what is happening to the already existing manufacturing industries? Africa is deindustrializing rather than industrializing (Grabowski,2015). What are our leaders not getting right in order to boost industrialization in Africa? Is it our opening up for competition in our industrial sector (trade openness) or rather trade protectionism?

In the quest to increase the economic growth of emerging economies, varieties of trade policies and exchange rate policies were introduced. These policies appear to be in support of the Trade Openness campaign. Subsequently, these trade policies and exchange rate policies were introduced in the early 1990s in the African continent which appears to be in great recognition in SSA as a means of boosting economic growth and development (Edwards, 2003).

Trade Openness is a measure of economic policies that either restrict trade or open up to trade with other nations. For example; in restricting trade, the country sets high tariffs; to open up trade with other countries, the country removes trade barriers by lowering its tariffs. Trade Openness and Trade Liberalization have been

a popular concept that promotes industrialization. Trade Openness helps increase exports (Dobre, Cuza, Ia, & Lv, 2008), which generates positive externalities for the entire economy. Free trade results in acceleration in growth. Smaller economies can adopt technologies from developed economies at a faster rate resulting in growth, industrialization and convergence than when there is trade protectionism. Trade Openness promotes economic growth and leads to greater economic efficiency. Trade is noted to be a major determinant of high incomes and growth by welfare economists. Trade promotes competition which leads to an efficient allocation of resources. Trade also makes it possible for knowledge and technology to be transferred from one country to another and this affects the cost of production leading to the expansion of factories. However, considering the cost and risk associated with new technologies, technological interdependence and complementarity may hinder technological diffusion and knowledge transfer to new and young manufacturing firms (Antonelli, 2014). Some empirical findings of trade openness Dobre et al, (2008); Aboubacar, Xu, & Ousseini, (2014); Keho, (2017), argued that trade is an engine of economic growth. Import and export are channels through which countries could demand products produced from other countries. The export expansion increases production (output). A rise in production and output implies that industries are expanding leading to an increase in employment. Dobre et al., (2008); Aboubacar, Xu, & Ousseini, (2014); Keho,(2017), argued that trade openness enhances the efficient allocation of resources through the adaptation of technologies from other industrialized countries to improve production. Hence, developing countries like SSA economies that are

more open to international trade will grow faster than economies that are less exposed to international trade.

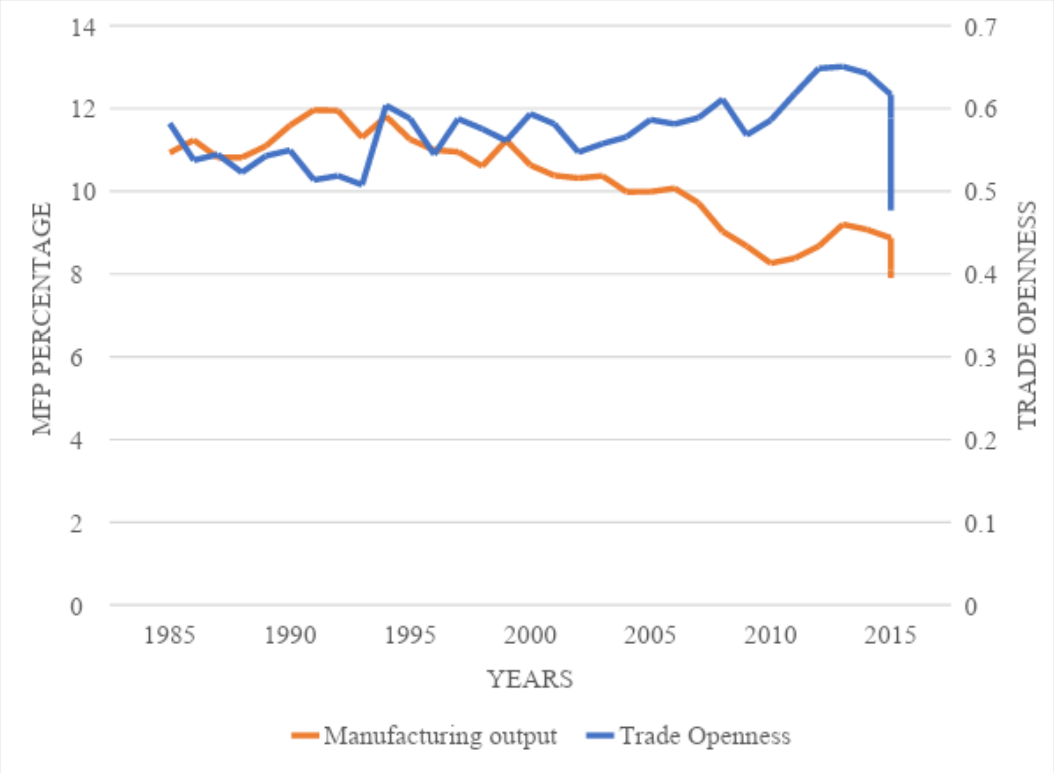

Figure 3. Manufacturing output and Trade Openness in sub-Saharan Africa
Source: Ayirikame (2021)

This argument was based on the traditional measurement for trade openness (export +import /GDP). In figure 3 shown above, from 2000 to 2017, most countries in SSA have opened to trade with the rest of the world but the manufacturing output continues to decline. Between 2012 and 2015 trade openness has gone as high as 0.6878 and could not have much impact on the manufacturing output. This is because much of the trade openness was based on the import of consumable goods as against the export of raw materials. Though trade openness has driven the economic growth in SSA mainly in the service and the extraction sector due to

China's insatiable want for natural resources to develop their manufacturing sector. This growth is transitory and may not lead to major structural changes and long-term economic development. It may also not lead to the creation of better pay jobs and boost the standard of living among the populace. What prompted an empirical study is the trend of the manufacturing industry underperformance in SSA despite the increase in trade openness.

International trade goes hand in hand with the exchange rate. Most African countries have serious exchange rate problems, it is always rising (depreciation) (Aghevli, Khan & Montiel, 1991). The exchange rate is the price at which one country's currency is exchanged for another country's currency and it happens in the foreign exchange market. An example is an over-the-counter transaction. The dealers of the foreign exchange market are the central banks, commercial banks, brokers, businesses, and investors. The foreign exchange market involves purchasing and selling foreign currencies, for example; buying the US dollar or selling the US dollar to get the domestic currency for transactions in the domestic country. There are two forms of transactions in the foreign exchange market, spot and forward transactions. The spot transaction involves buying and selling of the foreign currency on the same day or it may take two or three days for delivery of the foreign currency while the forward transaction involves agreements between two parties. That is, the buyer and the seller of a foreign currency are to supply a certain amount of foreign currency at a future date against payment of domestic currency at a certain exchange rate agreed upon in a given contract.

Some factors determine the exchange rate of a country. These are; the Balance of Payment, inflation, money supply, interest rate, among others. The Balance of Payment (BOP) is a key factor that determines the exchange rate. It indicates how much a country is importing and exporting. Thus, it reflects the demand and supply of foreign exchange which invariably determines the value of the domestic currency. A country gets foreign exchange through the exportation of both visible and invisible goods and services representing the supply side. The demand for foreign exchange is a result of the importation of both visible and invisible goods and services. Exporters receive foreign currency and give it out for domestic currency which increases the demand for domestic currency. This creates excess demand which leads to the appreciation of the domestic currency. Importers also have to exchange the domestic currency for foreign currency to be able to buy foreign goods and services. However, this activity creates an excess supply of the domestic currency causing the domestic currency to depreciate.

Export and import determine the position of the BOP while depreciation and appreciation of the local currency refer to as exchange rate fluctuations. A severe form of exchange rate fluctuation is exchange rate volatility. A nation that is constantly experiencing a BOP deficit tells us that the nation is importing more than exporting. Hence, the supply of the local currency is more than the demand for the local currency triggering the domestic currency to lose value in the foreign exchange market. Also, the interest rate has implications for the movement of short-term capital. This is only possible in a financially open economy. A country that has a high-interest rate will attract short-term capital inflows. All things being

equal, many inflows cause the domestic currency to appreciate while a country with a low-interest rate than the world interest rate would experience capital outflow. Much capital outflow will cause depreciation of the domestic currency. The correction of the BOP deficit of a country depends on whether that country is practicing a fixed or a flexible exchange rate system. Under the fixed exchange rate system, the correction of the BOP deficit lies in the hands of the government while the correction of the BOP deficit in a flexible exchange rate system is determined by demand and supply (Aghevli, Khan & Montiel, 1991).

The exchange rate is a problem in SSA because most raw materials are imported by the manufacturing industries (Mendes, Bertella, & Teixeira, 2014). Could the exchange rate fluctuations be the possible cause of deindustrialization and unsustainable industrialization (manufacturing) in Africa? The African exchange rate has been highly volatile since the 1980s where most African countries began with the flexible exchange rate system Achouak et al (2018). The adoption of the flexible exchange rate system was followed by financial sector liberalization policies as part of the economic recovery program which exposed most SSA countries to continue exchange rate fluctuation (Achouak et al 2018). Since the adoption of the flexible exchange rate system in the 1980s, most SSA countries' currencies have depreciated against the major currencies; the US dollar, the Pounds, and the Euros (Adewuyi & Akpokodje, 2013). The exchange rate volatility has a major implication on the countries' BOP as well as the manufacturing industry development (Adewuyi & Akpokodje, 2013).

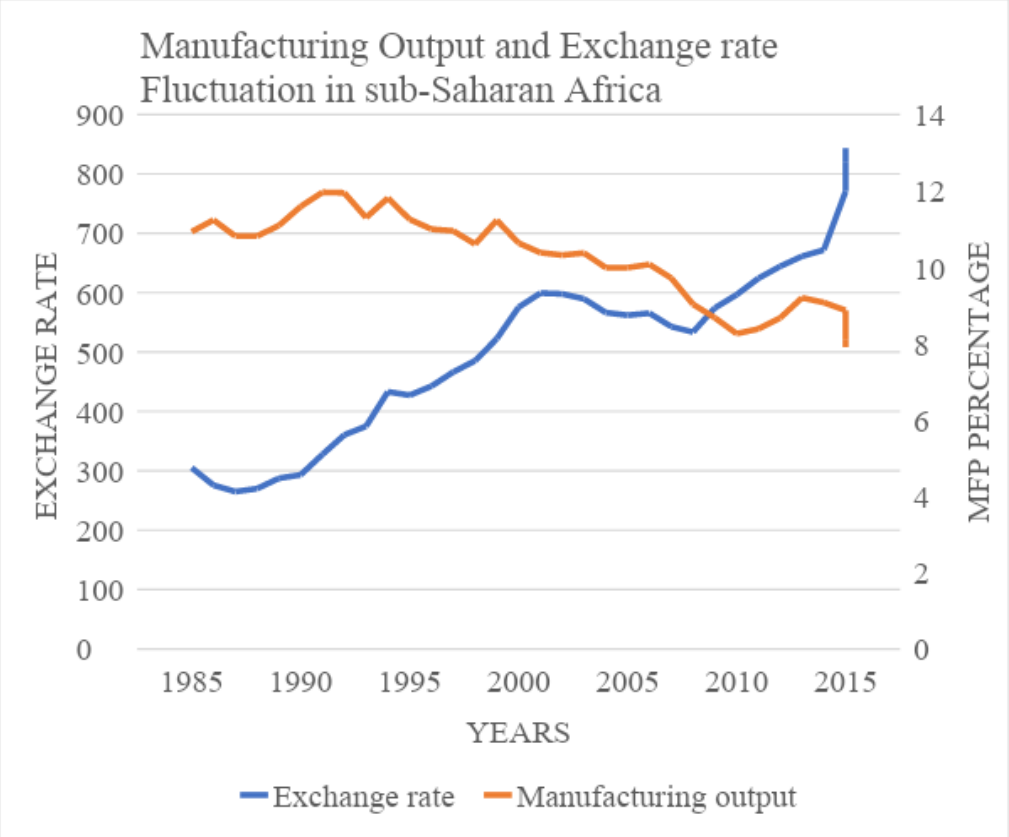

Figure 4. Manufacturing Output and trend of the Exchange rate in SSA. Source: Ayirikame (2021)

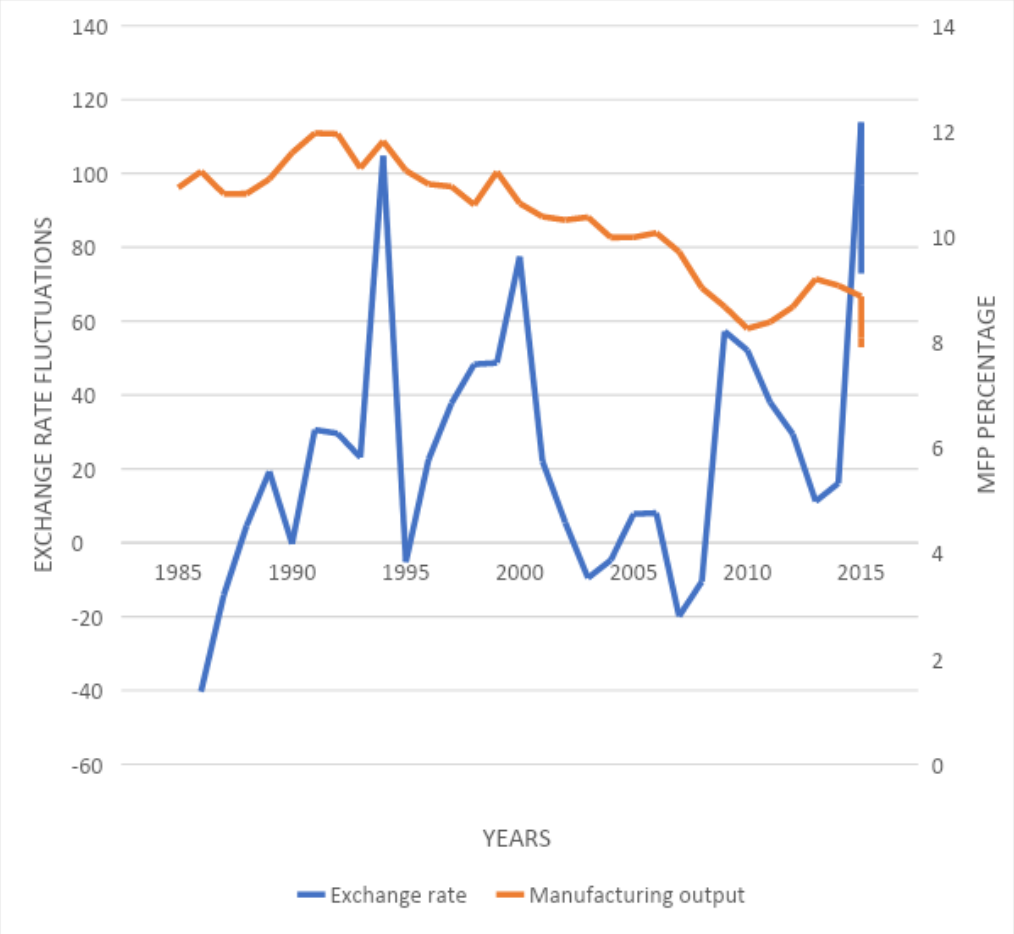

Figure 5. Manufacturing Output and Exchange rate Fluctuation in SSA.
Source: Ayirikame (2021)

Figures 5 and 6. The trend of exchange rate and exchange rate fluctuations respectively in SSA is continuously rising and the manufacturing output continues to decline; this has implications for the growth of the manufacturing industry in SSA.

The productions of SSA manufacturing firms are largely dependent on imported inputs because machinery is not much available in SSA countries. When the exchange rate increases (local currency depreciates), it leads to the high cost of the firm's imported inputs which translates into high prices of the firm's products

and that may reflect in the slow development of the manufacturing industry in the region. Some empirical evidence of exchange rate fluctuations Achouak et al (2018);s Alagidede & Ibrahim, (2017); Nonejad & Mohammadi, (2016) argues that exchange rate fluctuation hurts economic growth and the effect becomes severe in financially openness economies. Also, very little attempt has been made to examine the effect of exchange rate fluctuations on the manufacturing output in SSA. Ehinomen and Oladipo, (2012); Abdul-mumuni, (2016); Omotola (2016), Akinlo, (2018) have examined exchange rate fluctuations and the manufacturing industry growth without the inclusion of trade openness as an explanatory variable while Ehinomen & Oladipo, (2012); Abdul-mumuni, (2016); Omotola (2016) also studied country-based analysis in which there are some methodological issues and Akinlo, (2018) did the study on sub-Saharan Africa in which his study took into consideration exchange rate volatility but not exchange rate fluctuations.

Statement of the Problem

The manufacturing sector industrialization has always been a major objective of every government. Through industrialization, developing nations seek to achieve high economic growth. Also, the sustainable development goal 9 (SDG-9) has stipulated that by 2030 each country should have achieved sustainable industrial and infrastructural development (UN, 2015). In line with the SDGs, the African Union introduced Agenda 2063, which stated that manufacturing and industrial development will be the main focus for Africa to meet its developmental goals (AU, 2015). In the quest to increase the economic growth of developing nations, varieties of trade policies and exchange rate policies were introduced.

These policies were introduced in the early 1990s in SSA as a means of boosting economic growth and development. Yet, it remains uncertain whether the approach of trade openness and exchange rate policies implementation in SSA has indeed, been successful in transforming the manufacturing industry. Trade openness and exchange rate fluctuations on economic growth have been largely investigated by most researchers. Most of these studies have been either, to examine the effect of trade openness and economic growth or to examine the effect of exchange rate fluctuations on economic growth (Akinlo,2018; Achouak *et al*., 2018; Alagidede & Ibrahim, 2017; Mireku, 2017; Keho, 2017; Mireku *et al*., 2017; Hye, Lau, and Tourres, 2014; Aboubacar, et al 2014; Afaha, and Oluwatobi, 2012). Amidst these several studies, it's important to note that, sector disaggregation of the effect of trade openness and exchange rate fluctuations is inconclusive, that is, the effect of trade openness and exchange rate fluctuations on manufacturing output. It is also worth mentioning that variables used in previous studies had issues with measurement errors, that is trade openness variable. Almost all the studies reviewed that used trade openness as the explanatory variable used "export plus import divided by GDP as a proxy for trade openness" which does not show the ease with which countries do business, which also does not include the tariffs of export and import. More importantly, other studies did not consider the interactions of trade openness and electricity and the threshold effect of trade openness on manufacturing output in SSA. Hence, they have records of inconclusive results. Therefore, many scholars remain uncertain whether the approaches of trade openness policies and exchange rate fluctuations policies have indeed been

successful in transforming the manufacturing sector of SSA. This creates difficulty for policymakers to manipulate policies to achieve the main objective of sustained industrial growth in the manufacturing sector of SSA. Hence, there is the need to relook at the measurement of trade openness and consider the new trade policy openness as argued by Cantah, et al (2016) to analyze the effect of trade openness on manufacturing output in SSA. This measurement is appropriate because it indicates the easiness of trade activities and tariff levels in each country.

Therefore, these gaps open a new area for research into the manufacturing sector of SSA. We then seek to examine the effects of trade openness and exchange rate fluctuations on manufacturing output in SSA. Our study differs from other studies in three dimensions. We use the new trade policy openness index and exchange rate fluctuations to examine their effects on manufacturing output. The World Bank Enterprise Surveys, which report on perceptions of the challenges faced by a representative sample of firms across Africa. Almost all the firms considered in the studies reported that electricity is their major constraint, (Scott, Darko, Lemma, & Rud, 2014). The poor quality of electricity supplies in SSA was perceived by SMEs to have a negative impact on their operations. Voltage fluctuations and power outages usually halt production, damage equipment and affect product quality (Scott, et al, 2014). Since electricity in SSA over the years has become a major problem that has affected the manufacturing sector in SSA (Blimpo & Cosgrove-Davies, 2019) there is the need to interact trade openness with electricity to find the net effect. We will then interact trade openness with electricity to test the joint effect of trade openness and electricity on manufacturing output in

SSA. Theoretically, it has been established that trade openness leads to manufacturing sector growth. Thereby causing most countries in SSA to implement the trade openness policies in their economies. Yet the expected growth in the manufacturing sector has not been experienced. Could the low growth of manufacturing industries be attributed to the low rate of electricity production in the region? Thirdly, we will test the threshold effect of trade openness on manufacturing output.

Purpose of the Study

This study explores the effects of trade openness and exchange rate fluctuations on manufacturing output in SSA.

Specific Objectives

Specifically, the study seeks to:

1. Estimate the effect of trade openness and exchange rate fluctuations on manufacturing output in SSA.
2. Examine the joint effects of trade openness and electricity on manufacturing output in SSA.
3. Test the threshold effects of trade openness on manufacturing output.
4. Determine the differences in the effects of trade openness and exchange rate fluctuations on manufacturing output across non-resource countries, non-oil and oil exporters in SSA

Research Hypothesis

The following hypotheses were tested

H_0: Trade openness and exchange rate fluctuations do not have effects on the manufacturing output in SSA.

H_1: Trade openness and exchange rate fluctuations have effects on manufacturing output in SSA.

H_0: Both Trade openness and electricity have no effects on manufacturing output in SSA.

H_1: Both Trade openness and electricity have effects on manufacturing output in SSA.

H_0: Trade openness has no threshold effect on manufacturing output**.**

H_1: Trade openness has a threshold effect on manufacturing output**.**

H_0: There are no differences in the effects of trade openness and exchange rate fluctuations on manufacturing output across non-resource countries, non-oil and oil exporters in SSA.

H_1: There are differences in the effects of trade openness and exchange rate fluctuations on manufacturing output across non-resource countries, non-oil and oil exporters in SSA.

Significance of the Study

The study would be useful to policymakers, especially, Ministry of Trade and Industry (MoTI) of SSA countries. This study would enable policymakers to know the kind of trade policies to be implemented to promote the manufacturing industry in their respective countries. Also, it will serve as a guide to policymakers to understand the level of competition that may be good for the development of the manufacturing industry. Information gathered on the relationship between exchange rate fluctuations and manufacturing output will be beneficial to the Central Banks of SSA countries. Central Banks and Governments will understand the level of the exchange rate that is good in promoting the manufacturing sector growth, employment, and structural change. This study is also useful in the context of Sustainable Development Goals-9 (SDGs-9). Also, it is useful to the African Union's Agenda 2063, African Continental Free Trade Area (AfCFTA) and Africa Industrialization policy. It will also contribute to the existing literature.

Scope of the Study

The study seeks to explore the effects of trade openness and exchange rate fluctuations on the manufacturing output in SSA. The decision to use trade policy openness (tariffs rate, cost of import and export, the number of days it takes to complete import and export transactions, the number of documentation involved in import and export) as a measure of trade openness and exchange rate fluctuations (the difference between appreciation and depreciation) is due to the prolonged declined in the manufacturing output in sub-Saharan Africa. There has also been a long debate on whether trade protectionism or trade openness and exchange rate

fluctuations could be the possible cause of the slow growth of the SSA manufacturing sector.

Limitations

Despite a lot of efforts made to ensure that these study results are objective and reliable, this study faced the following limitations: lack of funds to pay for some data, unavailability of data for some SSA countries, the time frame for the study is limited. Notwithstanding the above limitations, the results of this study are still valid.

Definition of Terms

The following terms are defined in the context of this research for a better understanding of this study.

Manufacturing Output: This refers to an additional value being added to raw materials to become intermediates and finished goods. Manufacturing Output is therefore the total output produced by the manufacturing industry in a country.

Trade Openness: This is the ease with which a country does business with the rest of the world, considering its trading policies that relate to tariffs, processing of imports and exports.

Exchange Rate Fluctuations: Exchange Rate is the price at which domestic currency is exchanged for foreign currency. Exchange Rate Fluctuations are the appreciation and depreciation of the domestic currency against the US dollar.

Real Interest Rate: Interest Rate refers to the cost involved in borrowing capital for investment catering for inflation

Inflation: This refers to the spontaneous increase in the general price level of goods and services.

Electricity: Electricity refers to a form of energy or electric power used to power every technology and machine to work well.

Gross Fixed Capital Formation: This refers to the national savings, domestic capital stock including factories, plant equipment, and improvement to land.

Foreign Direct Investment: Refers to investments that a company makes outside its home country.

Organization of the Study

This study is divided into five chapters. Chapter One deals with the introduction, which comprises, background to the study, statement of the problem, the purpose of the study, statement of the research hypothesis, the significance of the study, limitations of the study, definition of terms and organization of the study. The second chapter presents the literature review which is made up of both theoretical and empirical reviews. Chapter Three explains the research methods as follows; the introduction, research design, sample selection and data sources, justification of variables, model specification, empirical model specification. Chapter Four involves the analysis of results, empirical findings and Chapter Five concludes the study. It comprises summary, conclusion, and recommendations

CHAPTER TWO

LITERATURE REVIEW

Introduction

This chapter discusses the core issues in the literature that are related to the area of study. To do this review, the study discussed the overview of the manufacturing industry in SSA, the theoretical underpinnings to the problem that has to do with the relationship between trade openness (TDOP) and exchange rate fluctuations (EXCFLU) and manufacturing output (MFP) in SSA. The chapter is organized into four main parts. The first part is the overview of the manufacturing industry in SSA, the second looks at the theoretical review for TDOP and manufacturing growth. The third part assesses the theoretical review for EXCFLU and MFP and the fourth part deals with the empirical review for TDOP and MFP, EXCFLU and MFP.

Overview of the Manufacturing Industry in SSA

In SSA today, the manufacturing industry plays a major role in economic transformation. There is growing unemployment among the teeming populace in the region where out of ten workers, only one finds employment in a well-paid job. The rest of the unemployed population are forced to settle for low-paying jobs often called self-employment (Bhorat, Kanbur, Rooney, & Steenkamp, 2017). In the last four decades, the SSA manufacturing industry has been on the constant decline (Bhorat, Kanbur, Rooney, & Steenkamp, 2017). Despite the declining nature of the SSA manufacturing industrial sector, the SSA manufacturing exports have grown

faster from 50 billion US dollars in 2005 to 100 billion US dollars in 2014. In 2017 SSA manufacturing share to GDP was about 145 US dollars. Globally, the SSA manufacturing share to GDP has grown from 75 billion US dollars in 2005 to about 157 US dollars in 2014. The annual growth rate of SSA manufacturing output has been 3.5% from 2005 to 2014 which is faster than the rest of the world (Sign, 2018). However, this is not as strong as it should have been in creating well-paid jobs and reducing unemployment in SSA.

At large, the manufacturing sector is still contributing to employment and GDP in SSA. As shown in Table 1 below, the SSA manufacturing industries include Derba Cement in Ethiopia which creates about 700 jobs in Ethiopia, Indorama Elame Fertilizer and Chemicals Firms in Nigeria which transform natural gas into urea fertilizer, other manufacturing industries in Nigeria include food and beverages processing, cigarette production, textiles, oil refiners, pharmaceutical and automotive industries which contribute about 9 percent to Nigeria's GDP. Textile and Apparel Industry, the Volta Aluminum Melting Company (VALCO), glass and plastics production, wood processing in Ghana contribute to GDP and employment in Ghana. In Kenya, the manufacturing industries include Dairy, chemicals fabricated metals production, textiles, pharmaceuticals, furniture, leather goods, and motor vehicles. These manufacturing industries have provided over 280,000 jobs for the people of Kenya. Zambia, despite its landlocked nature, is doing well in terms of its manufacturing products with an average growth rate of about 30 percent mostly in the agro-processing and production of consumer goods

(Dinh, Palmade, Chandra, & Cossar, 2012; Bhorat, Kanbur, Rooney, & Steenkamp, 2017; Industrialise Africa, A.D.B., 2019).

The SSA manufacturing industry has progressed from import substitution industrialization during post-independence to private sector-led industrialization. This was due to the economic recovery programs prescribed by the IMF and World bank through trade liberalization in the early 1990s (Edwards, 2003). Trade liberalization in the early 1990s exposed the manufacturing sector to intense competition from the most efficient productive economies such as Japan and Asia. Also, the rising depreciation of SSA currencies, high-interest rates, high cost of production rendered most domestic manufacturing firms inefficient. The collapse of the Ghana Aluminum Industry (VALCO), and the declined performance of the textile industry in Ghana are classic examples (Ackah, Adjasi, & Turkson, 2014.)

However, the SSA manufacturing industry has a comparative advantage coming from low labor costs and abundant natural resources, although there is significant variation across SSA countries. These natural resources could be used for the expansion of the manufacturing industry in SSA if they are well managed (Dinh, Palmade, Chandra, & Cossar, 2012).

According to Dinh et al, (2012), the SSA manufacturing industry relied greatly on the creation, expansion of domestic markets for local manufacturers. Thus, offering new opportunities such as the Africa Continental Free Trade Area (AfCFTA), the establishment of Special Economic Zones (SEZs), would improve regional integration for the SSA manufacturing sector. In recent times, the SSA

manufacturing industry has seen improvement in intra-African trade in manufactured goods of about 10 percent in 2000 to 16 percent in 2014. Angola is leading with rapid growth in its manufacturing sector of about 18.3 percent annually, followed by Nigeria of about 11.8 percent growth rate annually (Sign, 2018). Examples of some manufactured products in SSA in Table 1.

Table 1: Manufacturing industry and products produce

Manufacturing industries	Value-added (products)
Food and beverage manufacturing	Baked goods, grains, fruits and vegetable preserved, animal meat, non-alcoholic and alcoholic drinks, ice, fats and oil, chewing gum,
Tobacco product manufacturing	Cigarette, cigars, cigar form, loose tobacco products, snuff
Textile manufacturing	Fiber, apparel, sheets, towels, curtains, yarn, thread, fabrics mills, lace goods, etc.
Leather and allied (rubber and plastics) manufacturing	Leather, rubbers, plastics, tires,
Wood products and paper manufacturing	Lumber, plywood, veneers, flooring, paper products
Petroleum refining and coal manufacturing	Refine different product of fuel, (petrol, gas) coal, compounding lubricating oil and greases
Table 1: continues	
Manufacturing industries	Value-added (products)
Pharmaceuticals and chemicals manufacturing	Pharmaceuticals, soaps, cleaning compound, fertilizers, pesticides
Metal and fabricated metal manufacturing	Iron, steel, aluminum, cutlery, hand tools, springs, screws, nuts, and bolts
Machinery manufacturing	Agricultural machines, construction machines, mining machines, heating motor vehicles, planes, ships, trains, engines, air conditioners etc.
Electronics manufacturing	Computers, phones, communications equipment, audio, and visual equipment
Furniture manufacturing	All furniture, mattresses, blinds, cabinets, and lighting
Measuring, analyzing and controlling instruments manufacturing	Surgical and dental instruments, watches and clocks, etc

Source: Ayirikame (2021)

Theoretical Review

Trade, knowledge spillover, and growth are channels through which countries can grow faster Grossman & Helpman, (1991). The theory indicated that trade generates positive externality that works hand in hand with externality from domestic innovations to facilitate technological transfer.

The trade, knowledge spillover and growth theory work this way, Grossman and Helpman (1991) assumed an entrepreneur would invest in research and development to come up with an innovative product to increase profit margins of their business. The entrepreneur that had embarked on scientific research to produce new knowledge depends on the level of the country's scientific engineering and industrial know-how, which Grossman and Helpman (1991) called the Knowledge Capital. This stock of knowledge capital grows as a result of the frequent interactions the local researchers have with international researchers and the business environment. The Stock of Knowledge Capital grows up to a certain point and then becomes public good because the originators of an idea cannot stop people from using the idea or may not be able to fully extract the benefit of their stock of innovation, the spillover is created as a result of the innovation. Grossman and Helpman stated that through innovation, researchers make new scientific discoveries that go beyond what entrepreneurs can earn from their patent rights. The new ongoing discoveries add to the body of information (Knowledge Capital) in the research community and the country's benefits.

A country that has a high stock of knowledge capital from research and development has the feature of spillover benefit. When a less endowed country

trades with a residence of the high endowed stock of knowledge capital country, the less endowed country gains access to this accumulated knowledge capital as well as the ongoing discoveries. Grossman and Helpman, (1991) argued that the spillover benefits between two nations doubles as a result of increasing in their trade activities. The volume of trade represents imports and exports. Therefore, policies that enhance trade (import subsidy and export subsidy) between domestic countries and foreign countries help to increase the production of MFP and in the long run promote growth (Grossman & Helpman, 1991). Hence, we expect that if developing countries in SSA trade with industrialized economies, they would be able to tap the scientific techniques and product innovations from these industrialized countries to improve the production of manufactured products in the region leading to an increase in the manufacturing output at a minimum cost.

Also, the theory of exchange rate fluctuations (Kandil & Dincer, 2008) stated that EXCFLU can be divided into two predicted and unpredicted shocks of the exchange (fluctuations). The predicted refer to perfect foresight that rational producers and consumers can foresee future fluctuations in the exchange rate and plan their investments and consumption pattern to meet these fluctuations. The unanticipated shocks of the exchange rate refer to unexpected fluctuations (uncertainties) that arise from the exchange rate. Kandil and Dincer said demand and supply are channels through which exchange rate fluctuations can be seen through the output supplied. They argue that the output of an economy generally rests on unexpected fluctuations in the exchange rate.

The theory works this way, unexpected local currency appreciation against foreign currency will cause imports to be less costly and exports of the domestic goods to become expensive in the international market. Thus the domestic country becomes less competitive in the international market. The foreign demand for domestically produced goods decreases causing producers to cut down production and prices of their products. However, on the supply side, unexpected local currency appreciation makes importation of capital goods and intermediate goods cheaper which goes into production to increase the MFP of the domestic economy. The increase in output will cause prices of goods and services to decline. Kandil and Dincer (2008) concluded that output, growth, and inflation are determined by the net effect of currency appreciations.

Empirical Literature Review

Trade Openness and Manufacturing Output

Levchenko, Giovanni, and Levchenko (2009) studied trade openness and output volatility, taking into consideration industry-level panel data and trade. They tested the following hypotheses; trade openness affects output volatility of individual sectors; trade openness influences the co-movement between the economy. The study period was from 1970 to 1999 for 61 countries and 28 industries. The authors employed both OLS and ten-year panel specification models. Giovanni and Levchenko argued that trade openness across countries affects aggregate volatility. Trade has frustrated the smoothening of the business cycle over the period. The authors went ahead to divide the countries into two groups, developed and emerging economies. It was found that trade openness

caused the output of developing countries to be more volatile and less diversified. Developing countries have lower average co-movement of sectors that makes trade openness and aggregate volatility vary greatly depending on countries' characteristics. The authors stated that country characteristics are the main differences that account for trade sector-level volatility. Giovanni and Levchenko concluded the higher a sector is opened to trade, the more volatility in that sector. Also, TDOP leads to an increase in specialization. TDOP increases the aggregate volatility of a typical emerging economy five times more than a typical advanced economy.

Chandran (2009), revealed a positive long-run relationship between TDOP and manufacturing sector growth in Malaysia. The data spanned from 1970 to 2003 and the author adapted the ARDL to estimate the long-run relationships. The study also used a UECM to test the short-run disequilibrium correction. The author checked for unit root as a means of indicating variable stationarity using the Phillip-Perron (PP) test. Granger causality test was used to test the causal relationship between the variables. Chandran found that all variables were integrated at order I(1). Also, the Granger causality test indicated that TDOP does not Granger cause MFP in the short run. He recommended that export openness of manufacturing output and import openness of manufacturing machinery should be considered by policymakers.

Das and Paul (2011) examined TDOP and the growth of the Asian economy using the GMM estimation method from the period 1971 to 2009 for 12 developing economies in Asia. The objective of their study was an empirical verification of the

link between TDOP and real GDP in emerging Asian economies. Their findings have shown that TDOP positively influences the real GDP of emerging Asian economies.

Effiong (2013) made a sector-specific analysis and found that TDOP had significant long and short-run positive outcomes on MFP in Nigeria. The ARDL technique was employed for the cointegration analysis combined with ECM to check for disequilibrium correction. Also, CUSUM and CUSUMSQ bound test was meant for stability testing. The author used the ADF and PP unit root test to check for stationarity. Effiong, (2013), found that the variable manufacturing index was integrated at I(0) while the rest of the variables were integrated at I(1), implying non-stationarity. Findings worth noting from his study; interest rate spread negatively affects Nigeria MFP and the exchange rate positively affects Nigeria's MFP. The CUSUM and CUSUMSQ statistic is stable. The study recommended that policymakers in Nigeria focus on openness policies that strengthen Nigeria's comparative advantage in the manufacturing sector. The data spanned was from 1970 to 2008.

Aboubacar et al (2014) analyzed the effects of TDOP on the economy of Niger. The direction of the relationship, and the magnitude of influence that TDOP has on the Niger economy. The authors employed the Johansen Multivariate Cointegration Test and VECM Models for the analysis of long and short-run relationships. Also, the Granger Causality Test was used to test the direction of causality of the variables. The authors considered the period from 1980 to 2013 and the results of their findings revealed that there exists a long-run relationship

between economic growth and TDOP, real exchange rate, FDI. They further showed that there was unidirectional causation (TDOP and exchange rate granger cause economic growth). Aboubacar, Xu, & Ousseini, concluded that TDOP positively influences Niger's economy. Besides, the exchange rate depreciation positively increases Niger's economy in the long-run. None of their explanatory variables affect Niger's economy in the short-run. They recommended policies geared towards export expansion and diversification especially into value-added products which will be helpful for Nigeria's economic growth.

The study by Mushtaq, Nazir, Ahmed, and Nadeem, (2014) revealed that TDOP positively relates to manufacturing output in five South Asian countries. Based on the Hausman test, the researchers used a fixed effect to estimate the coefficients for their objective of the study: the impact of TDOP on manufacturing output. The panel data that was used for the study spanned from 1980 to 2011 for five South Asian countries (Bangladesh, India, Nepal, Pakistan, and Sri-Lanka). The authors also found that economic growth and government expenditure had a significant effect on manufacturing output while inflation was insignificant. They recommended that the five South Asian countries should promote export and decrease imports to increase their manufacturing output.

Elhiraika, Aboubakar and Muhammad (2014) explored the role of economic transformation in promoting the manufacturing industry and the growth of GDP in Africa. The authors used 50 African countries from 1980 to 2009, with the following objectives; assessing the key determinant of growth in the share of manufacturing output to GDP, determining whether higher economic growth is

associated with higher manufacturing output. The researchers employed the GMM estimation technique to specify three equations with manufacturing output being the dependent variable and the independent variable are GDP growth rate, FDI, trade openness, human capital, institutional quality. They argue that GDP growth had a positive significant influence on the manufacturing output in Africa, an increase in GDP will stimulate growth in the share of manufacturing to total output. The findings further revealed that trade openness and human capital have no significant impact on manufacturing output in Africa. On the other hand, manufacturing output also had a positive significant impact on the growth of African GDP. The researchers then concluded that domestic investment in the manufacturing sector should be encouraged to stimulate economic growth in Africa. They stated that industrial policy and industrialization is the central theme for structural transformation in Africa.

Ulaşan (2015) examined trade openness and growth nexus in a dynamic panel data model from 1960 to 2000 using the GMM estimation technique. The researcher measured trade openness in two ways; import plus export to current GDP ratio at current prices and total trade to GDP ratio at constant prices. These are referred to as current openness and real openness respectively. The author used the neoclassical growth model to hypothesize that trade openness influences economic growth. The findings suggested that current trade openness, real trade openness, and import duties do not influence economic growth and the results are not significant.

Divyasree-PP (2015), examined the impact of exchange rate intervention and trade openness on the economies of BRICS countries from the period 1998 to 2012 for a total of five countries (Brazil, Russia, India, China, and South Africa). The objectives of his study focused on exchange rate intervention and trade openness on share price movement; evaluated the impact of exchange rate intervention and trade openness on inflation; assessed the long-run relationship between exchange rate, trade openness, and GDP. Divyasree-PP adopted panel data models where fixed effects and generalized methods of the moment were estimated. He found that within all five countries, exchange rate fluctuations are insignificant while trade openness is highly significant in explaining economic growth in BRICS. Also, all the five countries in BRICS had an increase in foreign exchange reserves, the share price movement was positive and significant that explained the stability of investment in BRICS. Exchange rate and trade openness have a positive and significant influence on inflation. It was also found that both the exchange rate and trade openness have long-run relationships with GDP thereby influencing economic growth in BRICS.

Keho (2017) examined the impact of trade openness on economic growth in Cote D'Ivoire using ARDL bound test to cointegration and the Toda Yamamoto Granger causality test from the period 1965 to 2014 in a multivariate framework. The author hypothesized that trade openness affects economic growth in Cote D'Ivoire. The findings suggested that trade openness has a positive significant effect on economic growth in Cote D'Ivoire which supports the trade-led growth hypothesis in both the short run and long run. The study also revealed that there is

a long-run relationship between economic growth, capital stock, labor, and trade openness. The researcher concluded that the country's trade composition should be manufactured goods exports that result in more structural changes and economic growth.

Mireku, Agyei, and Domeher (2017) studied trade openness and economic growth in Ghana for the period 1970 to 2013 with the objective of investigating the short-run and long-run dynamics of trade openness and economic growth in Ghana. The authors adopted the Auto-Distributive Regressive Lag (ARDL) bound test to cointegration in their analysis. The results of the study revealed that trade openness has a positive significant relationship with economic growth volatility. The authors argued that the positive relationship between trade openness and economic growth was due to the rise in Foreign Direct Investment (FDI) in oil investment and multinational corporations. The researchers also found a negative relationship between financial openness and economic growth volatility. Mireku et al, (2017), concluded that trade openness has a positive long-run relationship with economic growth volatility and a negative long-run relationship between financial openness and economic growth volatility. Therefore, they recommended that policymakers should consider encouraging export-led growth by specializing in the production of export commodities through tax incentives policies.

Nketiah, Cai, Adjei, and Boamah (2019) investigated FDI, trade openness, and economic growth in Ghana. Their focus was on the interrelationship among FDI, trade openness and economic growth. The dynamics of FDI, trade openness, and economic growth were estimated using time series data from the period 1975

to 2017. They employed the OLS estimation technique in their analysis and ADF test for unit root. The results of the study revealed that trade openness has a positive influence on economic growth while FDI and inflation were statistically insignificant. The authors recommended that policies that lead to more openness should be encouraged. Exports and FDI inflows should also be encouraged to boost output growth in Ghana.

Exchange Rate Fluctuations and Manufacturing Output

Ehinomen and Oladipo (2012) explored the effect of exchange rate management on Nigeria's manufacturing sector performance covering the period from 1986 to 2010. The study adopted the Ordinary Least Square Estimation (OLS). The findings of their study indicated that exchange rate appreciation had a positive relationship with manufacturing output in Nigeria and that exchange rate appreciation promotes growth in the Nigerian manufacturing sector. The findings have further shown that there exists a positive significant relationship between inflation, foreign direct investment, and manufacturing GDP. The authors used a dummy to capture the government exchange rate management team that deliberately devalued the currency, the dummy indicated insignificantly and does not contribute to the growth of the manufacturing sector. The authors concluded that the exchange rate management policies which were geared towards depreciation of the currency had no significant effect on manufacturing sector growth in Nigeria, rather exchange rate appreciation policies should be pursued. They recommended that, since Nigeria's manufacturing sector depends largely on imported inputs, the government should intensify every effort to achieve exchange

rate appreciation. However, for the importation of inputs not to continue in the near future, the government should put in place measures to improve technology and develop local inputs as well as improve agricultural sector production.

Chatterjee, Dix-carneiro, and Vichyanond (2013) analyzed the effect of exchange rate shocks on the export of multi-product firms from 1997 to 2006. The authors built a theoretical model to show how producers respond to exchange rate fluctuations. The Brazilian customs data were used to test the theoretical predictions of exchange rate fluctuations and how Brazilian firms respond to exchange rate movements. The Panel Fixed Effect and Ordinary Least Square (OLS) estimation technique were used in the analysis. The authors found that the relative position of a product in a firm is a significant determinant of producer price elasticities to real exchange rate movement. The authors also tested producer prices following a real depreciation of the exchange rate and found that multi-product firms adjust prices, product scope, and distribution channels of sales across products to mitigate the effect of the exchange rate. That is firms increase product range and the producer prices following a depreciation of the exchange rate. They observed that an increase in producer prices was greater for the firms' main product, hence they concluded that real exchange rate depreciation leads to a reduction in the skewness of sales within a firm.

Dhasmana (2013) examined the effect of real exchange rate variation on the manufacturing sector performance in India. The sample period covered from 2000 to 2012 and involved 300 Indian manufacturing firms. Based on the Hausman test the random effect estimation technique was used in the analysis. The findings

indicated that labor and investment growth have a positive significant relationship with output while labor cost growth and sales growth were negatively related to output. However, the interactions between export, import, and real exchange rate were insignificant. The author argued that exchange rate appreciation strongly affects revenue channels than cost effects operating through low prices on imported inputs. He said, the market share of a firm determines its response to exchange movement and that a firm that has a low market share would experience a greater impact from exchange rate movement on its output, while a firm with higher market share would experience low impacts from exchange rate fluctuations on its output. Dhasmana, (2013), concluded that the real exchange rate movement affects the firm's revenue and cost channels. Exchange rate appreciation affects exports and exchange rate depreciation affects imports but the degree of impact depends on the firm's market power.

Ojo and Alege (2014) examined exchange rate fluctuations and economic performance in sub-Saharan Africa using dynamic cointegration analysis from 1995 to 2007 for 40 countries. The objective of their study is to assess the link between exchange rate fluctuations and output, income, and other macroeconomic variables. The authors adapted a GMM and error correction panel cointegration. The authors observed that inflation and trade openness are inversely related to exchange rate fluctuations. They argued that countries that are more open to trade experienced greater depreciation of their currencies. They further found that the interest rate highly determined the movement of the exchange rate. Also, the study indicated that there is a long-run relationship among the variables, there is a bi-

directional relationship between exchange rate and inflation, trade openness, interest rate. The authors concluded that policymakers should take steps to probe into determinants of the exchange rate and diversify their exports.

Vaz and Baer (2014) explored the real exchange rate and manufacturing growth in Latin America. The sample period was from 1995 to 2008 for 39 countries and 22 manufacturing firms in Latin America. The study used unbalanced panel data with the GMM estimation technique to ascertain the effect of currency overvaluation or undervaluation on manufacturing output in Latin America. It was found that manufacturing output in Latin America was much affected by currency overvaluation. It was also found that import and export affected real exchange rate movements that had to affect the growth of the manufacturing industry. The authors recommended that the undervaluation of the currency could be seen as a growth strategy.

Abdul-Mumuni (2016), studied exchange rate variability on the manufacturing sector performance in Ghana using ARDL to test the short-run and long-run relationship between exchange rate variability and manufacturing output. The study period was from 1986 to 2013. The results of the study indicated that there is a short and long-run relationship between exchange rate variability and manufacturing sector performance. Abdul-Mumuni further revealed that exchange rate depreciation had a significant negative effect on the manufacturing sector's performance while exchange rate appreciation improves the manufacturing sector. The author then recommended that appropriate policies should be put in place to check the exchange rate depreciation. Also, the importation of goods that can be

produced locally should be reduced. A good business environment for the manufacturing sector to survive should be encouraged.

Sani, Hassan, and Azam (2016), empirically examine the effects of exchange volatility on the output level of five ECOWAS English-speaking countries. The study period covered 1991 to 2014 for Gambia, Ghana, Liberia, Nigeria, and Sierra-Leone. The authors employed a cointegration test and error correction model to test for the short-run and long-run dynamic relationship between exchange volatility and output levels for each country. The study revealed that there exists a short and long-run relationship between exchange rate volatility and output in all the countries considered under the study. The results from the study further indicated that exchange rate volatility had a positive significant impact on output levels in Ghana, the Gambia, Nigeria, and Sierra Leone but exchange rate volatility had a negative significant effect on output level in Liberia.

Omotola (2016), studied the effect of exchange rate fluctuations on the manufacturing sector output in Nigeria. The study period was from 1986 to 2014. The study adopted the ARDL estimation technique to test the short-run and long-run relationship between exchange rate fluctuations and manufacturing output. The findings suggested that there exists a short and long-run relationship between exchange rate fluctuations and manufacturing output. However, the results further indicated that exchange rate fluctuations had a positive but insignificant effect on manufacturing output in Nigeria. The author recommended that policymakers should put in place policies that promote export and reduced imports to the achievement of balance of payment. Also, manufacturers should be encouraged to

use more local raw materials and reduce imported raw materials to make the manufacturing industry more competitive in the international market.

Nonejad and Mohammadi (2016) examined the effect of exchange rate fluctuations on economic activities in Iran. The study used time series data from 1978 to 2010 and adopted the ARDL estimation technique to test the short run and long run estimation between exchange rate fluctuations and GDP, private consumption, investment, export, import. The authors found that exchange rate fluctuations had a negative influence on GDP, private consumption, investment, import, and export. But unexpected depreciation of the currency had a positive significant effect on export and a negative effect on private consumption, investment, import, and GDP while an unexpected appreciation of the currency had a positive influence on private consumption, GDP, investment, import, and negative impact on export. The authors recommended that the government and policymakers should support investors in the event of shocks to reduce the effect of the shocks in the economy. They further suggested that the government should use appropriate monetary and fiscal policies to promote productivity and investments.

Zamir, Amin, Ullah, and Khan (2017), assessed the effects of exchange rate volatility on selected macroeconomic variables in Pakistan covering the period from 1980 to 2014. The objectives of their study were to empirically find out the macroeconomic variable that had led to Pakistan's exchange rate volatility and to examine the effects of exchange rate volatility on foreign exchange reserve, and other macroeconomic variables. The study used time series data and employed the

ordinary least square estimation (OLS) in the analysis. The authors conducted various unit root tests to check for stationarity to avoid spurious regression. To address the objective the authors made exchange rate volatility to be the dependent variable and found that inflation, foreign direct investment and imports had a negative relationship with exchange rate volatility while GDP per capita and exports had a positive relationship with exchange rate volatility in Pakistan. Also, the exchange rate volatility was used as an explanatory variable and the results of the findings suggested that there exists a negative relationship between exchange rate volatility and foreign exchange reserve imports but a positive relationship with GDP per capita and exports. Zamir, Amin, Ullah, & Khan, (2017) recommended that the central bank of Pakistan should lower the discount rate and yield on Treasury bills from time to time to reduce the cost of borrowing and also regulate the transfer of securities.

Mijiyawa, (2017) explored the key drivers of structural transformation using the manufacturing sector in Africa as a case study. The period considered was from 1995 to 2014 for a four-year panel data for 53 countries. The study adopted the system Generalized Method of Moment (GMM) technique of estimation. The results of the study indicated that currency depreciation against the US dollar promotes manufacturing activities in Africa while currency appreciation hurts the manufacturing sector. Further findings suggested that good governance is a key factor in the manufacturing sector development in Africa. Population size had a positive significant effect on the manufacturing industry hence the need for regional integration in Africa. But the urbanization rate and FDI had a positive and

insignificant effect on manufacturing output in Africa. Mijiyawa, (2017), recommended that the maintenance of a stable exchange rate policy is key to the development of the manufacturing sector in Africa. The author further recommended that African governments should pursue good governance, reduction in corruption, and regional integration.

Fetene, (2017) assessed the effect of real exchange rates on manufacturing export in 10 East African countries covering the period from 1995 to 2013. The methodology used in this study was Panel Autoregressive Distributed Lag (ARDL) to test for short-run and long-run relationship between real exchange rate and disaggregated manufacturing export. The empirical findings suggested that there exists a long-run relationship between real exchange rate and manufacturing exports. The author indicated that the real exchange rate depreciation promotes the manufacturing export in the long run while in the short-run real exchange rate depreciation improves labor-intensive, low and medium-skill manufacturing exports. Fetene Bogale, (2017) concluded that exchange rate devaluation in East Africa is crucial for manufacturing export to grow. He recommended that policymakers should put in place long-term policies aiming at boosting the manufacturing export and long-term devaluation of East African currencies should also be considered to promote manufacturing export performance in East Africa.

Akinlo, (2018) explored the impact of exchange rate volatility on the manufacturing sector in sub-Saharan Africa from 1980 to 2015. The study used GARCH (1, 1) to generate the exchange rate volatility, the pooled OLS, fixed effect, and the system GMM estimation techniques were adopted for the analysis.

The author stated that the GMM estimation was used for robustness checks. The results of the study revealed that previous manufacturing output has a negative significant effect on manufacturing output. The results from pooled OLS indicated that GDP and physical capital have a positive significant effect on manufacturing output while exchange rate volatility had a negative effect on manufacturing output. However, trade openness and interest rate are negative but insignificant. Also, the results from the fixed effect indicated that GDP and exchange rate volatility have a negative significant effect on manufacturing output, and the inflation rate is positive but insignificant. However, trade openness and interest rate remained negative and insignificant. The author concluded that the negative relationship between exchange rate volatility and manufacturing output is an indication of the low performance of the manufacturing sector in sub-Saharan Africa. The author further argued that the negative impact of the exchange rate volatility could be traced to the two-channel importation of raw materials by SSA manufacturing industries; the exchange rate affects the prices of imported raw materials and the uncompetitiveness of SSA manufactured products in the international market. The author recommended that governments and policymakers should put measures in place to reduce imported raw materials and encourage the use of local raw materials. The author further recommended that governments should provide a conducive environment for the smooth functioning of the manufacturing sector.

Critique of the Literature

So far, it is clear that the evidence on the nature of the relationship between trade openness and exchange rate fluctuations on manufacturing output is mixed

and inconclusive; the reason being that most of the literature reviewed considered only trade openness and economic growth but did not consider studies on trade openness and manufacturing output, that is, sector-specific. Also, the literature did not look at trade openness and exchange rate fluctuations in manufacturing output together. Furthermore, there was no interaction term in all the literature reviewed so far. For the exchange rate fluctuations and manufacturing output literature reviewed, trade openness is mentioned as a control variable as it appeared not to be significant. Besides, some studies used ordinary least squares, even though several variables in the manufacturing output and economic growth models were not stationary. Hence the null hypothesis would be wrongly rejected in such analysis. Furthermore, almost all the studies reviewed that used trade openness as an explanatory variable used "export plus import divided by GDP" as a proxy for trade openness. This measurement could result in bias conclusions because it does not capture the tariffs and trade policies of a country. Hence, there is the need to relook at the measurement of trade openness as argued by Cantah, Brafu-insaidoo, Agyapong, & Adams, (2016). The new measurement of trade openness is trade policy openness (Cantah, Brafu-insaidoo, Agyapong, and Adams 2016). This measurement is appropriate because it indicates the easiness of trade activities and tariff levels in each country. This study uses the new trade policy openness as a proxy for trade openness. Therefore, this study examines the effect of trade openness and exchange rate fluctuations on manufacturing output in SSA.

Conclusion

Chapter two discussed the overview of the SSA manufacturing industry and the literature review. The overview of the manufacturing industry presents the major role play by the manufacturing sector in the region in terms of economic transformation and some manufacturing industries and their products. The theoretical review provided theories that explained how trade openness and exchange rate fluctuations transmit into the manufacturing sector growth. The theories of trade, knowledge spillover and growth, and rational expectations were reviewed. In addition, the empirical review showed the studies conducted on trade openness and exchange rate fluctuations on manufacturing output in SSA and the gap that exists. The literature review highlighted how trade openness and exchange rate fluctuations have effects on economic growth. This provided a gap in the literature for the current study to be conducted to ascertain the effects of trade openness and exchange rate fluctuations on manufacturing output in SSA.

CHAPTER THREE

RESEARCH METHODS

Introduction

This chapter deals with the methodological framework within which the effect of trade openness and exchange rate fluctuations on manufacturing output in sub-Saharan Africa is situated. The chapter discusses the methods that are employed to achieve the aim of the study. It is organized into the following sections: research design, sample selection data sources, justification of variables, model specification, empirical model specification measurement of variables and expected sign.

Research Design

The study follows the Positivist Philosophy and employs the quantitative design in its analysis. The World Bank doing business indicators data used to generate trade openness indexes does not provide enough observations to estimate either cross-sectional or time series equations. Consequently, panel data gives increased observations to estimate regression models. The available options for panel data estimations are static and dynamic panel data models. These take into account both individuals and time effects for all variables considered. Theoretically, it has been argued that past values of the dependent variable have an effect on the current values of the dependent variable. If the lag of the dependent variable is not included as an explanatory variable, it will result in misspecification. The dynamic panel model which makes use of the Generalized Method of Moment

(GMM) should be estimated to correct for misspecification and endogeneity. This means that the lag values of the dependent variable should be included as an explanatory variable in the model. This is because there may be a correlation between country-specific disturbance and the determinants. Also, there is the possibility of the explanatory variables being jointly determined with the dependent variable. To solve these problems, there is a need to remove time-invariant disturbances hence the need for instrumental variables. The GMM combines the first level and first difference using lagged variables as instruments for the first difference specification (Arelleno-Bond 1991; Bond & Blundell, 1998).

However, according to Torres-reyna, (2007), if T is less than 20-30 years (time series) and cross-sectional unit (N) is substantially larger than T but less than 25-30 units, fixed and random effect is more appropriate. Moreover, Wooldridge, (2012, PP. 511) argued that when N is larger than T, and both N and T are less than 30 units the static panel is recommended with robust estimation to correct for serial correlation. According to them, past values of the dependent variable that may cause endogeneity may not be a problem. Therefore, in this study, both the static panel and the dynamic panel models will be estimated to avoid misspecification. The selections between static and dynamic panel data models will be empirically verified to ensure a robustness check.

The researcher use panel data in the analysis due to the advantages panel data has over other forms of estimation. The use of panel data allows for an increase in observations and a range of variations of variables. The use of panel data helps to reduce omitted variables bias, but when the omitted variable is fixed over time,

panel data offers another tool for eliminating the bias. Panel data reduce multicollinearity among explanatory variables. The use of panel data allows for the study of the dynamic effect and accounts for individual-specific heterogeneity. It also has more degree of freedom and can improve the accuracy of econometric estimates hence it gives better inferences than cross-sectional data. Panel data is also better at detecting and measuring effects that cannot be observed in either cross-section or time series and minimize the effects of aggregation bias. Since the study is covering sub-Saharan Africa (SSA), it is expedient for us to use the panel data model in our estimation.

The static panel data model would be estimated. Also, the fixed effect and the random effect would be estimated for the static panel data and the Hausman test would be used to select between fixed effect and random effect. The null hypothesis (H_0) states that the random effect is consistent and efficient and the fixed effect is consistent but not efficient while the alternative hypothesis (H_1) states that the fixed effect is consistent and random effect is inconsistent. A rejection of the null hypothesis suggests that the fixed effect would be selected.

The fixed effect is also known as the Least Dummy Variable (LSDV). A dummy variable is included in the model to capture each country-specific for each constant. The fixed effect helps to establish a specific relationship between the dependent variable and the independent variable within the group. It assumes individual phenomena have different intercepts in an equation. The fixed-effect model explains both the cross-sectional dimension and time series of the panel and the intercept explains the individual effect. The fixed effect intercept may vary

across time but each effect is time-invariant, that is, the individual effect does not vary over time. The dummy variable is included to capture the variation in the cross-section. The functional form of the fixed effect model is presented in equation (1).

Fixed effect model.

$$y_{it} = (\mu + \alpha_i) + X'_{it}\beta + \varepsilon_{it} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(1)}$$

y_{it} is the dependent variable, μ is intercept, X'_{it} is the vector of control variables, β is the vector of coefficients, the errors are independent and identically distributed is $\varepsilon_{it} \sim IID(0, \sigma_v^2)$

The random effect model is an alternative estimator for the static panel data model. It does not have a fixed intercept, unlike the fixed effect. The random effect has one intercept for all observations and the error term varies across sections but constant overtime period. The individual effect is captured in the error term, that is, the random effect is designed to omit individual effect and also overcome the omitted specific effect through the modeling of the error term structure. It is assumed not to have an unobserved effect (individual effect) correlating with the explanatory variables in each period. Hence the random effect estimator uses the Feasible Generalized Least Square (FGLS) to estimate the unobserved effect. The functional form for the random effect model is presented in equation (2).

Random effect model

$$y_{it} = \mu + X'_{it}\beta + (\alpha_i + \varepsilon_{it}) \text{ ………………………………….. (2)}$$

y_{it} is the dependent variable, μ is intercept, X'_{it} is the vector of control variables, β is the vector of coefficients, the errors are independent and identically distributed is $\varepsilon_{it} \sim IID(0, \sigma_v^2)$ and $\alpha_i$is the individual specific effect (country) for a fixed or random effect.

The dynamic panel model which makes use of the Generalized Method of Moment (GMM) is used to correct for misspecification and endogeneity. The GMM instrumental variable (IV) estimator helps to correct the problem of endogeneity. In the case where predetermined variables are endogenous, the system GMM estimator proposed by Bond and Blundell, (1998) is most efficient to correct that. The concept of IV estimation allows you to be able to identify an instrument that can correct the endogeneity problem in the model. However, there is difficulty in searching for a valid instrument. This problem was however solved by Bond &Blundell (1998) who used the lagged variables in the model as instruments to solve the problem of endogeneity.

GMM model specification

$$Y_{it} = \delta Y_{i,t-1} + X_{it}\beta + U_{it} \text{ ……………………………………………….. (3)}$$

Where i=1, 2……N; t=1,2, ………..T; $U_{it} = \mu_i + \varepsilon_{it}$

y_{it} is the dependent variable, $Y_{i,t-1}$ is the lag of the dependent variable, μ is intercept, X'_{it} is the vector of control variables, β is the vector of coefficients, ε_{it} is the error term.

For the threshold analysis for objective three, we adopt the Hansen, (1999) model in analyzing our panel threshold. Hansen (1999), proposed the fixed effect to be used for threshold analysis for non-dynamic panel data with individual fixed effects. Hansen introduces a threshold variable into the fixed-effect model which uses the least square method of estimation technique. He developed a bootstrap procedure to test for the statistically significant threshold effect. The threshold variable becomes a discrete variable that splits the individual's observations into two based on the value of the observed variable known as the threshold parameter. The threshold parameter is a scalar and it is randomly determined from the data. This threshold parameter is then used to generate the threshold variable. This will generate two equations to be tested. The threshold model specification for the threshold analysis is presented in the following equations, (Hansen, 1999).

Threshold model

$$Y_{it} = \alpha_i + \beta_1 X_{it}(q_{it} \leq \gamma) + \beta_2 X_{it}(q_{it} \geq \gamma) + \delta h_{it} + U_{it} \text{ ..... (4)}$$

Simplicity $Y_{it} = \begin{pmatrix} \alpha_i + \beta_1 X_{it} + u_{it}, & q_{it} \leq \gamma \\ \alpha_i + \beta_2 X_{it} + u_{it}, & q_{it} \geq \gamma \end{pmatrix}$ .....(5)

which implies that $\beta = (\beta_1 + \beta_2)$,

$$Y_{it} = \alpha_i + \beta X_{it}(\gamma) + \varepsilon_{it}. \text{ ..... (6)}$$

The observations are divided into two differentiated with two regression slopes β_1 and β_2. Y_{it} is the dependent variable, X_{it} is the explanatory variable, ɣ is the hypothesized specific threshold value (threshold parameter), α_i is the specific fixed effect heterogeneity for each observation, β_1 is the threshold coefficient when the observations are lower than ɣ, and β_2 is the threshold coefficient when the observations are greater than ɣ (threshold parameter), q_{it} is the threshold variable, h_{it} is the other control variables, ɠ is the coefficient of the control variables and U_{it}, ε_{it} are the error terms. We will then determine whether the threshold effect is statistically significant or not, by stating the hypothesis: the null hypothesis state that, there is no threshold effect (H_0: $\beta_1 = \beta_2$), the alternative hypothesis state that there is a threshold effect (H_1: $\beta_1 \neq \beta_2$). If (H_0: $\beta_1 = \beta_2$) holds then there is no threshold effect between trade openness and manufacturing output. Moreover, if (H_1: $\beta_1 \neq \beta_2$) holds it indicates that the threshold effect exists. The F statistic is used to examine the presence of the threshold effect and the Sup-Wald statistic is used to test the null hypothesis (Hansen, 1999).

Sample Selection and Data Sources

The study gathers data from the World Development Indicators (WDI) database on annual exchange rate fluctuations, manufacturing output, real interest rate, inflation rate, gross capital formation, average tariff and electricity all measured in dollars from 2004 to 2017 for a sample of 24 sub-Saharan Africa countries. The cost of import and export, number of days to complete export and import and the number of documentations involved in export and import data were sourced from the World Bank Doing Business Indicators database. The criterion for the selection of

countries for Sub-Saharan Africa is based on the availability of data. The variables included in Constructing the trade openness index do not have data for some countries in SSA from 2004 to 2017. Also, for threshold estimation, balance panel data is needed. Hence, countries in SSA with missing data would not be selected for this study. Panel data for 24 SSA countries from WDI and World Bank Doing Business Indicators were employed for the study. The data set covers a fourteen-year panel of about 336 observations. In line with the objectives of the study, the data set is enough to meet the analysis of the study. The variables which are found in the data are: manufacturing output (manufacturing value added at current US dollars), trade openness index, exchange rate fluctuations, inflation rate, real interest rate, foreign direct investment, gross fixed capital formation, access to electricity and wage. Hence, the usage of the data to achieve the research objectives is most appropriate.

Justification of Variables

Dependent variable

Manufacturing output (MFP)

The manufacturing output is measured as value-added at current US dollars, which is the additional value added to raw materials to become intermediate and finished goods. Therefore, manufacturing output is the total output produced by the manufacturing industry in a country. We used manufacturing output (value-added) for each country as a measure of the manufacturing industry in SSA.

Independent variable

Trade openness (TDOP)

Trade openness (TDOP) is measured based on the ease with which a country engages in import and export with the rest of the world. That is its international trading policies - tariffs, the process of imports and exports, the number of days it takes to do cross-border trading as well as the number of documents it will take to complete import and export transactions.

A country that is open to international trade can increase output through export. According to Edwards (2003), openness to trade generates positive externalities which help boost other sectors of the economy. These positive externalities are technology transfer, knowledge and skills transfer, product innovations, etc. Factories (manufacturing industries) can adopt these technologies at a faster rate to increase production at a lower cost. The increase in production will lead to the expansion of the manufacturing industry thus leading to an increase in manufacturing output.

Principal Component Analysis

We create an index for trade openness using principal component analysis (PCA). The principal component analysis (PCA) will help us capture the cost of imports, the cost of exports, the number of days it takes to do import and export transactions, the number of documents involved in import and export, and the weighted mean tariff on imports and exports.

The cost of imports and exports takes into account the charges on a 20-feet container in US dollars. This cost includes; the cost of documentation, cost of

customs clearance, customs broker fees, cost on inland transport terminal and handling charges and tariffs on export and import. Amore open country is expected to have a lower cost of imports and exports than a less open country and a less open country is also expected to have a higher cost of imports and exports. The number of days it takes to import and export is measured by the time period from the beginning to the end of completion of the export and import. The number of documents involved in import and export transactions is measured by all documents that are needed for the shipment of import or export. These include contract documents that have been signed by both parties and documents for clearances by port and harbor officials, container terminal authorities, customs authorities, health, and technical control agencies and banks and government ministries. The tariffs measure all tariffs charged on imports and export. The data is obtained from the World Bank Doing Business Indicators (Cantah et al., 2016). The PCA will help to discover the structure of relationships among the variables included in the group which would have summed up by a number of mutually independent principal components. The first principal component has the maximum variance for any of the combinations. The number that would be generated from the principal components is noted and corrected with Kaiser-Meyer-Olkin (KMO). Therefore, we would use the first principal component as an aggregate measure of trade openness. Hence, we are expecting a negative sign between trade openness (TDOP) and manufacturing output.

Exchange Rate Fluctuations (EXCFLU)

The exchange rate is the price at which domestic currency being exchange for foreign currency. Exchange rate fluctuations are the appreciation and depreciation of the domestic currency. Exchange rate depreciation increases the price of foreign goods and makes domestic goods cheaper. The demand for foreign goods decreases as a result of the increase in their prices while the foreign demand for domestically produced goods increases because domestic goods have become cheaper due to the depreciation of the domestic currency. The increase in demand for domestically produced goods will lead to an increase in the production of manufactured products. By so doing, the manufacturing industry expands and becomes competitive in the international market. The increase in demand for domestically produced goods is not from only foreigners but also domestic consumers increase their demand for domestic goods because imports have become expensive. The increase in foreign demand will stimulate exports because exports have also become cheaper. On the other hand, exchange rate appreciation increases the price of domestic goods in the international market which decreases foreign demand for domestically produced goods because foreign goods become less expensive. The less expensive foreign goods will increase the domestic demand for foreign goods leading to an increase in imports. The decrease in demand for domestic goods by foreigners will decrease exports. The decrease in exports will lead to contraction of the manufacturing industry because internationally, the manufacturing industry becomes less competitive.

However, if the domestic manufacturing industry depends largely on imported raw materials then an appreciation of the domestic currency should lead to expansion of the manufacturing industry rather than contraction because imported raw materials become cheaper. On the other hand, a depreciation of the domestic currency leads to contraction of the domestic manufacturing industry because imports of raw materials become expensive. Hence, we expect a positive or negative sign between exchange rate fluctuations and manufacturing output.

Inflation Rate (INF)

The inflation rate refers to a spontaneous increase in the general price level of goods and services. A high inflation rate has a negative effect on demand for a domestic manufactured product. Inflation distorts the prices of goods and services in an economy. High inflation discourages investments because manufacturing firms are not certain as to what will be the future prices of their product. According to Fischer (1978), inflation increases the uncertainty of the general price level in the future. High inflation decreases productivity because factory owners are uncertain about their profit levels. However, it is argued that creeping inflation is good for investments, for example, a moderate increase in prices of manufactured products will stimulate manufacturers to increase production capacity in order to increase profit margins. We are expecting inflation to have a negative sign of manufacturing output. The consumer price index is used as a measure of inflation.

Real Interest Rate (INTRAT)

The real interest rate measures the cost of capital. The interest rate refers to the cost involved in borrowing capital. Manufacturers need capital to do business and pay later. Loanable funds are made available to manufacturing firms by financial intermediaries at a cost (interest rate or cost of borrowing). From Fisher's equation of quantity theory of money, the real interest rate is the nominal interest rate minus inflation. Hence, a high real interest rate depresses investment spending. From the neoclassical theory, if the real interest rate is high, it raises the cost of borrowing funds by the manufacturing firms for investments. With a high real interest rate, we expect manufacturing firms not to be able to borrow funds for investments, therefore we expect a negative sign.

Foreign Direct Investment (FDI)

Foreign direct investment (FDI) refers to investments that a company makes outside its home country. Usually, FDI is associated with long-term capital inflows which are targeted for long-term profit. Examples of these multinational corporations are Coca-Cola, MTN, Nestle, etc. FDI is very important for every country because it helps lift the infrastructure that adds to the capital stock of the country. Investments outside the domestic country are in two forms; international agents could either buy a portion of none controlled stock, bond or financial security to make funds available for investments or the international agencies such as the multinational companies could directly invest in a country and have direct control over the management of the business which contributes to economic growth. Most countries around the world today are putting policies in place to

attract FDIs into the manufacturing sector to help increase the growth of the manufacturing industry because FDI in general is acknowledged as a tool for economic growth. Therefore, FDI in this study is measured as a long-term capital investment in another country rather than the investor's country. We expect FDI to have a positive sign.

Gross Fixed Capital Formation (GCF)

Gross Fixed Capital Formation (GCF) refers to the national savings, domestic capital stock including factories, plant equipment, and improvement to land. Gross capital formation gives us an idea of how a country is saving out of its current resources for investments in social overhead capital goods such as buildings, machinery, new businesses, roads, etc. for future consumption. According to Solow, (1956) savings are important for economic growth. Components of saving as part of gross fixed capital formation include private savings, household savings, and government savings. These savings through bank deposits, mutual funds, insurance companies, equity markets, and corporate bonds get channeled to the manufacturing firms which are used for investments to expand factories. Expansion in the manufacturing industry leads to employment and industrial growth. The expected sign for gross capital formation is positive.

Electricity (ECL)

Electricity provides the power for every technology and machine to work well and it is important for every modern economy. The advent of electricity which replaced coalfields in the nineteenth century has brought overwhelming growth in

the manufacturing sector for many developed economies. Countries that formerly could not compete due to lack of coal. The driving feature of the first industrial revolution was the availability of cheap power to power the machines of manufacturing industries (Green & Zhang, 2013). The manufacturing industry uses a greater part of the total electricity production in a country to produce goods and services. Hence, the available and constant supply of electricity enables manufacturing firms to survive. Electricity is measured by access to electricity as a percentage of the population (ECL). We expect electricity to have a positive sign.

Wage

Wage is the benefit that a labor force receives as a result of engagement in the production of goods and services. Wage is a cost to the employer but a benefit to the employee. The price an employer pays for engaging every unit of labor service in the production of goods and services is called a wage. The cost of labor may be a major factor that can influence manufacturing decisions and manufacturing investments. The monetary compensation paid by employers (manufacturers) to employees for work done can be high or low. If it is high, it decreases the profit margin of employers which goes a long way to affect the manufacturing output. Thus, the wage is the cost of labor employed, hence, we expect a negative relationship between wage and manufacturing output. This study employs wage and salaries data from WDI for each country as a proxy for the cost of labor.

Table 2: Definition, Measurement and A-Priori Signs

Variables	Measurement of variables	The expected signs
MFP	Manufacturing output (value added (current US$))	
TRDOP	Trade openness index (tariffs, cost of import and export, number of days for import and export, number of documentations for import and export)	-
EXCFLU	Annual average exchange rate (LCU per US$, period average), (current year minus previous year = exchange rate fluctuations)	+/ -
INF	Inflation rate (consumer prices (annual percentage))	-
INTRAT	Real interest rate	-
FDI	Foreign direct investment inflows per Capita (USD)	+
GCF	Gross fixed capital formation percentage of GDP	+
ECL	Access to electricity (percentage of the total population)	+
WAGE	Wage and Salaries	-

Source: Ayirikame (2021)

General Model Specification (Static panel model)

$$Y_{it} = \mu + X_{it}\beta + U_{it} \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots. \quad (7)$$

Where $U_{it} = \alpha_i + \eta_t + \varepsilon_{it}$

α_i is the individual effect; it captures the impact of unobserved variables over time for a given individual and can vary between individual

η_t is the time effect; it captures the impact of unobserved variables which affect all individual alike in a given time period and can vary over time.

ε_{it} is the idiosyncratic error; it captures the impact of unobserved variables that vary between individual and over time.

Manufacturing output = f (trade openness, exchange rate fluctuations, inflation, real interest rate, foreign direct investment, gross fixed capital formation, access to electricity, wage)

LNMFP= f(TDOP, EXCFLU, INF, INTRAT, FDI, GCF, ECL, WAGE) respectively.

Empirical Model Specification for the fixed and random effect

$$LNMFP_{it} = \mu + \beta_1 TRDOP_{it} + \beta_2 EXCFLU_{it} + \beta_3 INF_{it} + \beta_4 INTRAT_{it} + \beta_5 FDI_{it} + \beta_6 GCF_{it} + \beta_7 LNECL_{it} + \beta_8 WAGE_{it} + U_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

$$LNMFP_{it} = \mu + \beta_1 TRDOP_{it} + \beta_2 EXCFLU_{it} + \beta_3 INF_{it} + \beta_4 INTRAT_{it} + \beta_5 FDI_{it} + \beta_6 GCF_{it} + \beta_7 LNECL_{it} + \beta_8 WAGE_{it} + \beta_9 EXCFLU_{it} * TRDOP_{it} + U_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (9)$$

$$LNMFP_{it} = \alpha_i + \beta_1 TRDOP_{it} + \beta_2 TRDOP_{it}(q_{it} \leq c) + \beta_3 EXCFLU_{it} + \beta_4 INF_{it} + \beta_5 INTRAT_{it} + \beta_6 FDI_{it} + \beta_7 GCF_{it} + \beta_8 LNECL_{it} + \beta_9 WAGE_{it} + U_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (10)$$

$$LNMFP_{it} = \mu + \beta_1 TRDOP_{it} + \beta_2 EXCFLU_{it} + \beta_3 INF_{it} + \beta_4 INTRAT_{it} + \beta_5 FDI_{it} + \beta_6 GCF_{it} + \beta_7 LNECL_{it} + \beta_8 WAGE_{it} + U_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (11)$$

Note: LNMFP = Log of Manufacturing Output, TRDOP = Trade Openness, EXCFLU = Exchange Rate Fluctuations, INF = Inflation Rate, INTRAT = Real Interest Rate, FDI = Foreign Direct Investment, GCF = Gross Fixed Capital formation, ECL = Access to Electricity, WAGE = Wage Rate

i=1, 2, …., N t=1,2, …, T, q_{it} = threshold variable, c=threshold parameter, α_i=fixed effect

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Empirical Model Specification for GMM

$$LNMFP_{it} = \mu + \beta_1 LNMFP_{it-1} + \beta_2 TRDOP_{it} + \beta_3 EXCFLU_{it} + \beta_4 INF_{it} + \beta_5 INTRAT_{it} + \beta_6 FDI_{it} + \beta_7 GCF_{it} + \beta_8 ECL_{it} + \beta_9 WAGE_{it} + U_{it} \quad \ldots (12)$$

$\beta 1, \beta 2 \ldots\ldots \beta 9$ are the parameters to be estimated, μ is a constant parameter and U_{it} is the error term

Note: LNMFP = Log of Manufacturing Output, $LNMFP_{it-1}$= Lag of Log of Manufacturing Output, TRDOP = Trade Openness, EXCFLU = Exchange Rate Fluctuations INF = Inflation Rate, INTRAT = Real Interest Rate, FDI = Foreign Direct Investment, GCF = Gross Fixed Capital Formation, ECL = Access to Electricity, WAGE = Wage Rate, i=1, 2, …., N t=1,2, …, T,

Specifically, equation (8) addresses objective one, equation (9) is for the estimation of the interactions between trade openness and electricity that is objective two, equation (10) is for testing the threshold effect in objective three and equation (11) is use to estimate objective four.

Post Estimation test for the fixed and random effect

The Hausman test is a technique proposed by Hausman (1978) to be used to decide between the fixed effect estimation and random effect estimation. To decide between the fixed effect and random effect estimation, we use the Chi-

square and p-value to reject the null hypothesis at a significant level of 5%. The null hypothesis states that, the random effect is consistent and efficient, meaning the random effect is preferred under the null hypothesis while the fixed effect is preferred under the alternative hypothesis, that fixed effect is consistent (Green, 2008).

Post Estimation test for GMM

The GMM estimator does not have many assumptions on the error term. Therefore, only a few post estimation tests are needed after GMM estimation (Wooldridge, 2012). Bond and Blundell (1998) proposed two post estimation tests for GMM. These are Arellano and Blundell test for autocorrelation (AR TEST) and the Sargan test of over-identification of restriction.

The AR TEST indicates the first and second order autocorrelation. The null hypothesis of AR TEST states that, there is no autocorrelation in the first difference error. For GMM results to be correct, the null hypothesis of AR TEST must not be rejected. Meaning, the probability value for the AR TEST should be bigger enough so that the null hypothesis cannot be rejected. Failure to reject the AR TEST null hypothesis suggests that there is no problem with autocorrelation in the model.

The second test is the Sargan test of valid over-identification of restrictions. The null hypothesis of the Sargan test states that, correct over-identification of restrictions. Which means that we should not reject the null hypothesis. Hence, GMM estimation requires that both AR TEST and Sargan test P values should be insignificant that is the null hypotheses should not be rejected.

Conclusion

Chapter three discussed the procedure involved in conducting this study by explaining the methodological procedure adopted. There is an indication that the study followed the quantitative method of analysis. It also shows the source of data and sample selection procedure.

Again, the theoretical panel data models were specified, out of which the empirical models were derived. Trade openness and exchange rate fluctuations were used as the main variable of interest, inflation rate, real interest rate, foreign direct investment, gross fixed capital formation, access to electricity, and wage were used as control variables to explain manufacturing output in SSA. Moreover, this study used balanced panel data, dynamic panel and estimate model - both the static panel (fixed effect (FE) and random effect (RE).

CHAPTER FOUR

RESULTS AND DISCUSSIONS

Introduction

The chapter presents the analysis and discussion of the results of the study. The chapter is structured into two parts. The first part provides the principal component analysis for the trade openness index and descriptive statistics of continuous variables. The second part looks at the empirical results from the panel model estimation with the discussions.

Principal Component Analysis

We used the Principal Component Analysis (PCA) as explained in the methodology to construct the trade openness index for 24 countries in Sub-Saharan Africa.

Table 3: Principal component analysis for trade openness

Component		PC1	PC2	PC3	PC4	PC5	PC6	PC7
Eigenvalue		3.535	1.517	.9863	.4720	.332	.0997	.0575
Variance Proportion		0.505	0.217	0.141	0.067	0.047	0.014	0.008
Cumulative Proportion		0.505	0.722	0.863	0.930	0.977	0.992	1.000
Variable	Vector 1	Vector 2	Vector 3	Vector 4	Vector 5	Vector 6	Vector 7	KMO
TARIFF	0.123	0.132	0.957	0.076	0.207	-0.059	0.019	0.479
DAYIMP	0.491	0.037	-0.058	-0.440	-0.099	-0.593	0.446	0.634
IMPCOST	0.443	-0.335	-0.040	0.453	-0.091	-0.396	-0.565	0.625
DOIMP	0.306	0.578	0.050	-0.055	-0.666	0.266	-0.228	0.476
DAYEXP	0.467	-0.056	-0.086	-0.493	0.485	0.409	-0.354	0.648
EXPCOST	0.427	-0.411	0.032	0.328	-0.163	0.498	0.516	0.640
DOEXP	0.229	0.603	-0.263	0.492	0.483	-0.049	0.193	0.419
KMO Overall								0.590

Source: Ayirikame (2021).

The first two eigenvalues of the two principal components (PC1, PC2) as indicated in Table 3 are used for the analysis since they are greater than one (1). The first principal component has an eigenvalue of 3.535 which explains about 51.0 percent of the total variations and in relative terms has a high positive coefficient. The second principal component has an eigenvalue of 1.517 which explains about 22.0 percent of the total variances. The two principal components cumulatively explain about 72.0 percent of the total variations in the seven variables. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy that is used to check the

appropriateness of the PCA is 0.59. This is greater than the minimum KMO criteria of 0.50 for PCA analysis. Since the first principal component explains more than 50% of the variation, this study uses the Eigenvectors of the first principal component as weights in constructing the trade openness index. Therefore, a trade openness index with a higher score will mean that there is less openness to trading activities which implies that there is a restriction to international trade. Hence, we expect a negative relationship between the trade openness index and manufacturing output.

Descriptive Statistics

This part of the study discusses in brief, the basic statistical properties of the continuous variables used in the model for the period 2004 to 2017. The examined descriptive statistics include the pairwise correlation table in Table 3, unit root test in Table 4, multicollinearity test in Table 5, and Table 6 contain the summary statistics of variables, means, standard deviation (overall, between and within), minimum and maximum. Once again, the variables used in the analysis include; Log of Manufacturing Output (LNMFP) (dependent variable)), Trade Openness (TDOP), Exchange Rate Fluctuations (EXCFLU), Inflation Rate (INF), Real Interest Rate (INTRAT), Foreign Direct Investment (FDI), Gross Fixed Capital Formation (GCF), Log of Access to Electricity (LNECL), Wage (WAGE) (independent variables)

Table 4: Correlation analysis

	Lnmfp	Tdop	EXCFLU	Inf	Intrat	Fdi	Gcf	Lnecl	Wage
Lnmfp	1								
Tdop	-0.299***	1							
EXCFLU	0.0794	0.0243	1						
Inf	-0.0274	0.0561	0.143**	1					
Intrat	-0.107*	0.205***	0.0209	0.135**	1				
Fdi	0.0293	-0.140**	-0.0709	-0.00717	-0.514***	1			
Gcf	0.114**	0.0369	0.115**	0.013	-0.221***	0.270***	1		
Lnecl	0.377***	-0.628***	-0.177**	-0.262***	-0.303***	0.334***	0.00478	1	
Wage	-0.136**	-0.164**	-0.1*	-0.0773	-0.230***	0.389***	0.127**	0.320***	1

Note: p < 0.10; * p <0.05; ** p <0.01; ***
Source: Ayirikame (2021).

The results of the correlation matrix presented in Table 4 indicate the correlation that exists between the variables. The correlation only shows the relationship that exists among the dependent and independent variables. From Table 4 some of the variables are positively related to each other while others are negatively related as indicated by the negative sign. Exchange rate fluctuations, foreign direct investment, gross fixed capital formation and electricity positively relate to manufacturing output while trade openness, real interest rate, inflation, and wages negatively relate to manufacturing output. However, we expect that variables should not have a perfect correlation, thus, when there is a perfect correlation, we run into the problem of multicollinearity. Therefore, a robustness check is performed to correct for multicollinearity in Table 5.

Table 5: Multicollinearity test

Variable	VIF	1/VIF
Lnecl	2.15	0.46429
Tdop	1.74	0.574633
Fdi	1.66	0.602526
Intrat	1.45	0.690741
Wage	1.24	0.804039
Inf	1.14	0.879536
Gcf	1.13	0.888623
EXCFLU	1.08	0.92954
Mean VIF	1.45	

Source: Ayirikame, (2021).

Table 5 indicates the result of the Multicollinearity test. The Variance Inflation Factor (VIF measures how much the variance of the estimated coefficient is inflated as a result of multicollinearity. Using the rule of thumb, any VIF value higher than 10.00 is an indication that there is multicollinearity. From Table 5

above, VIF results indicate no multicollinearity hence we proceed with the estimation.

Unit Root Test

Before performing the regression analysis, it is important to check for the stationarity of the variables. A variable is stationary when it means and variances are time-invariant. This condition is important because non-stationary variables generate spurious regression which results in biased estimated parameters. We used the Levin-Linchu ADF panel unit root test (Levin et al 2002) and I'm Pesaran, and Shin (IPS) panel unit root test (IM et al 2003) for the test. The null hypothesis states that all variables are non-stationary vis-a-vis the alternative hypothesis, all variables are stationary. The result of the panel unit root test is reported in Table 6 for both tests. The null hypothesis of non-stationary is rejected indicating that all variables are stationary at I (0). Hence, we proceed with the estimations.

Table 6. Result of Unit Root Test

Variables	The IPS (Im, Pesaran, and Shin) test ADF		The LLC (Levin-Lin-Chu) test ADF		
	Statistic	P-value	Statistic	P-value	
Lnmfp	-3.0153**	0.0013	-8.7815*** -14.6239	0.0000	adjusted t* Unadjusted t
Tdop	-1.9618**	0.0249	-6.4408*** -12.4960	0.0000	adjusted t* Unadjusted t
EXCFLU	-7.0003***	0.0000	-9.4000*** -20.5722	0.0000	adjusted t* Unadjusted t
Inf	-2.2343**	0.0127	-3.2782** -8.0738	0.0005	adjusted t* Unadjusted t
Intrat	-5.9643***	0.0000	-9.7989*** -15.8030	0.0000	adjusted t* Unadjusted t
Fdi	-4.3687***	0.0000	-3.7093** -10.6156	0.0001	adjusted t* Unadjusted t
Gcf	-2.5832	0.0049	-4.1266 ** -10.6631	0.0000	adjusted t* Unadjusted t
Lnecl	-5.8593***	0.0000	-10.2796*** -18.8329	0.0000	adjusted t* Unadjusted t
Wage	-0.9516	0.1706	-3.6384 ** -9.3790	0.0001	adjusted t* Unadjusted t
Ho: All panels contain unit roots Ha: Some panels are stationary			Ho: Panels contain unit roots Ha: Panels are stationary		

Note: p < 0.10; * p <0.05; ** p <0.01; ***
Source: Ayirikame (2021).

Summary Statistics

The cross-sectional unit is twenty-four (24) countries and the time period is fourteen (14) years. The total sample size is 336 (24*14). The country id is time-invariant; it shows the cross-sectional dimension of the data. Time id also shows the time dimension of the data span. The descriptive statistics of panel data consider three (3) variations. The overall, between and within variations as shown in Table 7.

Table 7: Summary Statistics

Variable	Variation	Mean	Std. Dev.	Min	Max
Country id	overall	12.5	6.93251	1	24
	between		7.071068	1	24
	within		0	12.5	12.5
Time id	overall	2010.5	4.037141	2004	2017
	between		0	2010.5	2010.5
	within		4.037141	2004	2017
Lnmfp	overall	20.86917	1.659944	17.29407	24.72658
	between		1.658842	17.60647	24.46041
	within		0.3323268	19.68528	21.60157
Tdop	overall	0.1841722	1.739887	-2.29053	6.016463
	between		1.549035	-1.972416	2.742669
	within		0.849007	-2.648938	5.098117
EXCFLU	overall	16.52706	67.22489	-153.4154	640.8569
	between		31.43701	0.063874	117.6789
	within		59.74322	-254.5672	539.7051
Inf	overall	10.25634	15.15642	-46.73334	106.5588
	between		9.719009	-6.761886	35.14137
	within		11.78658	-29.71512	81.67375
Intrat	overall	5.063296	18.28553	-138.4598	43.20329
	between		13.41259	-49.44683	21.74106
	within		12.70606	-83.94964	64.8416
Fdi	overall	63.10351	131.1613	-327.0847	880.2692
	between		103.6292	0.6349552	469.2629
	within		82.95197	-555.7707	577.5745
Gcf	overall	21.32751	7.078573	6.349849	42.7925
	between		5.746778	13.49685	32.33609
	within		4.285128	5.866108	38.82266
Ecl	overall	37.60499	24.64423	3.207317	92.48353
	between		24.14781	5.787095	85.71978
	within		6.844678	19.36355	75.76028

Table 7: Summary statistics continue

Wage	overall	31.01352	22.23231	5.954	85.838
	between		22.59606	6.606214	83.75614
	within		1.872799	24.02931	36.22031
Observations	N= 336				
	n=24				
	T=14				

Source: Ayirikame (2021).

From Table 7, lnmfp is the log of manufacturing output which has a mean of 20.86917 billion US dollars with the minimum variation from 17.29407 billion US dollars to a maximum variation of about 24.72658 billion US dollars. Therefore, the average manufacturing output in SSA annually is about 20.86917 billion US dollars. The standard deviations of manufacturing output is seen in the overall variation 1.659944, the between is 1.658842 and the within variation is 0.3323268. This means that there is more variation in manufacturing output across countries (between variation) than the variations in the manufacturing output of a country over time (within variations).

The average trade openness index (tdop) is 0.1841722 and ranges as low as -2.29053 to as high as 6.01641722 annually. The lower the trade openness index value, the more open the country is, to international trade. The overall variation of trade openness is 1.739887, between the variation of trade openness is 1.549035 and within the variation of trade openness is 0.849007. Meaning, there is more between variations than within variations that is trade openness index varies greatly across countries (between) than the variation in trade openness of a country over time (within).

Exchange rate fluctuations (EXCFLU) can be as low as -153.4154 and as high as 640.8569 with an average value of about 16.52706 per annum. The overall variation of exchange rate fluctuations across countries and overtime is 67.22489 annually. There is more variation in exchange rate fluctuations of a country from one year to another (within variations) than variations across countries (between variations). The within variation is 59.74322 and the between variations is 31.43701.

The average inflation rate (INF) in SSA is about 10.25634 US dollars and varies by -46.73334 as a low inflation rate to 106.5588 as a high inflation rate annually. The variation of inflation rate across countries is 9.719009 and the variations of the inflation rate of countries over time are 11.78658. The inflation rate varies more overtime than it varies across countries. The overall variation of the inflation rate is the variation across countries and over time which is about 15.15642.

The total amount of net foreign direct investment (FDI) inflows to SSA has averaged about 63.10351 billion US dollars. The maximum value of FDI is approximately 880.2692 billion US dollars with a minimum value of FDI of about -327.0847 billion US dollars. Gross Fixed Capital Formation (GCF) for SSA countries for the period is averaged at about 21.32751 billion US dollars. The minimum value of access to electricity (ECL) is 3.207317 and the maximum value of access to electricity is 92.48353. There are not many differences between the overall variation and between variations. The mean value of access to electricity as

a percentage of the total population of SSA is about 37.60499 percent. The dispersion of the variables from their means is measured by the standard deviation.

Empirical Results and Discussions

The objective of the study was to find the effect of trade openness and exchange rate fluctuations on the manufacturing output in sub-Saharan Africa. We went on to find the estimation technique that fit our data. We then estimated the GMM based on Arellano and Bond; Bond and Blundell method of estimation. The Arellano-Bond Autocorrelation Test (AR TEST) and the Sargan test for overidentification of restriction tests were done. The tests suggested that there was no autocorrelation of the highest order and the GMM overidentification test was passed.

Table 8: Dynamic panel data results (System GMM)

Variables		Two-step System GMM	
$lnmfp_{t-1}$		0.675	
		(-1.063)	
Tdop		-0.0938	
		(-0.580)	
EXCFLU		0.000906	
		(-0.00221)	
Inf		-0.00517	
		(-0.0229)	
Intrat		0.00266	
		(-0.0124)	
Fdi		-0.000655	
		(-0.00151)	
Gcl		-0.00373	
		(-0.03460)	
Lnecl		-0.281	
		(-1.643)	
Wage		0.033	
		(-0.113)	
Number of instruments		30	
Observations		312	
Number of countries		24	
Observation per group	Minimum	13	
	Average	13	
	maximum	13	
F-statistic ($\chi 2$)		2.58	
Prob.		0.014	
Test		Z	prob>z
AR test for autocorrelation	1	-2.08	0.037
AR test for autocorrelation	2	-0.40	0.689
Sargan over-identification test	$\chi 2$	2.79	P($\chi 2$)=0.835

Standard errors in parentheses p < 0.10; * p <0.05; ** p <0.01; ***

Source: Ayirikame (2021)

From the GMM results in Table 8, after passing the post estimation test, the lag of manufacturing output (dependent variable) turns out to be insignificant,

which Suggests that, pass values of manufacturing output do not have any effect on current manufacturing output. This result is in line with the findings by Ulaşan, (2015). Hence, the decision to use the static panel estimation (fixed effect and random effect) seems appropriate.

In estimating the static panel data model, we conducted a test between the pooled ordinary least square (OLS) and random effect using the Breusch-Pagan LM test for random effects versus pooled OLS. The null hypothesis states that (H_0 var(u)=0) no random effect (pooled OLS is appropriate), the alternative hypothesis states that, (H_1 var(u)=0) random effect is appropriate. The Breusch-Pagan LM test, the Chibar2 (01) = 1889.09, prob > chibar2 = 0.0000, from the p-value, we reject H_0 and conclude that random effect is appropriate.

We went further to test between the fixed effect and random effect using the Hausman test. Results can be seen in appendices. The Hausman test in Appendix A failed to reject the null hypothesis of differences in coefficients not systematic, that is no correlation between the regressors and individual heterogeneity (the random effect is consistent and efficient). Therefore, the random effect estimation technique is appropriate to address objective one. Thus, coefficients were derived from the random effect. The result for objective one is shown in table 9.

Table 9: Regression results from fixed and random effect for objective one

Dependent variable manufacturing output		
Independent variables		
	FE	**RE**
	Coefficient	Coefficients
Tdop	-0.154 ***	-0.154 ***
	(0.0258693)	(0.0242149)
EXCFLU	0.000544 *	0.000558 **
	(0.0002593)	(0.0002571)
Inf	-0.00699 ***	-0.00688 ***
	(0.0015584)	(0.0015291)
Intrat	-0.00578 ***	-0.00575 ***
	(0.0010036)	(0.0009778)
Fdi	0.0000326	0.0000372
	(0.0002258)	(0.0002207)
Gcf	0.00789	0.00874
	(0.0079282)	(0.0075331)
Lnecl	0.497 ***	0.507 ***
	(0.1013022)	(0.1013669)
Wage	0.00489	-0.000531
	(0.0215607)	(0.0159585)
_cons	19.00 ***	19.12 ***
	(0.5843166)	(0.5467874)
R2-overall	0.1122	0.1463
Hausman test (χ^2)		0.9335
F test /Wald chi2(8)	38.45 ***	353.21 ***

Note: p < 0.10; * p <0.05; ** p <0.01; *** robust standard errors in parenthesis ()
Source: Ayirikame (2021).

Main variables of interest

As expected, the result from Table 9 column 2 (RE) indicates that there is a negative relationship between the trade openness index and the manufacturing output in sub-Saharan Africa. . The inverse relationship shows that all things being equal, on average, a unit decrease in trade openness index increased manufacturing output in SSA by about 15.4 percent and it is statistically significant at one percent. The decrease in trade openness index means more openness to international trade

(that is low import and export cost, few numbers of days to complete import and export, low number of paper works to complete import and export, and low tariff rate). Also, if technology transfer is relatively rapid in the manufacturing sector, then it has additional stimulus to increase the manufacturing output in SSA leading to the manufacturing sector growth.

By implication, trade openness is an important indicator in explaining the manufacturing output growth in SSA. This result is in line with the Grossman and Helpman theory of trade openness and growth that leads to growth in the manufacturing sector. Also, this result confirms other empirical studies that found a positive relationship between trade openness (import plus export / GDP) and manufacturing output (Chandran, 2009; Effiong, 2013; Mushtaq, Nazir, Ahmed, and Nadeem, 2014). Through trade openness, the manufacturing industry in SSA has the opportunity to import inputs and export manufacturing output at low cost and also interact with industrialized economies which has an impact on the manufacturing sector of SSA. This result would be more pronounced if the openness to trade is coming from the manufacturing sector since most of the exports from SSA are basically primary products and the imports are consumer goods. This result supports the findings of Aboubacar, et al, (2014); Keho, (2017); Mireku, Agyei, and Domeher, (2017) who said, there is a positive relationship between trade openness and GDP. Also, this result is contrary to the finding by Akinlo, (2018) which stated that trade openness is insignificant but has a negative impact on the manufacturing sector of SSA. Moreover, Elhiraika, Aboubakar, and Muhammad,

(2014); Ulaşan (2015) also found no relationship between trade openness and manufacturing output.

Exchange rate fluctuations were estimated to be positive and significant at five percent (5%). It means that a unit increase in exchange rate fluctuations leads to about 0. 0558 percentage increase in the manufacturing output of SSA. This result is consistent with the study by Lawal, (2016) which explained that exchange rate fluctuations have a positive relationship with manufacturing sector output; Sani, Hassan, and Azam (2016) stated that exchange rate volatility has a positive effect on the output of West African Countries (ECOWAS) except Liberia which had a negative effect. A positive relationship means that all the SSA countries under this study benefited from the depreciation of their currencies which are dependent on the overriding effect of demand and supply channels as a result of the net effect of currency depreciation and appreciation on manufacturing output. In some countries whose manufacturing sector is heavily dependent on imported raw materials, when there is appreciation, leads to an increase in the manufacturing output.

Also, if there is depreciation, countries that import decrease their manufacturing output. SSA countries that export much of their manufacturing output benefit from exchange rate depreciation. Thus, an increase in exchange rate depreciation makes manufactured exporters more competitive in the international market leading to an increase in manufacturing output. However, it should be noted that the study by Alagidede and Ibrahim (2017); Akinlo (2018) for Ghana, and SSA which stated that the exchange rate has a negative effect on their

manufacturing sector implies that these countries depend heavily on import of raw materials for their manufacturing industries in the midst of depreciation. Furthermore, exchange rate depreciation favors export-oriented manufacturing industries as in the case of China which is an export-oriented manufacturing country that has devalued its currency to promote competitiveness in its manufacturing sector.

Control Variable in Table 9

The coefficients for the control variables as seen in Table 9 column 2 (RE) are significant while others are not significant. The var Inflation Rate (inf), Real Interest Rate (intrat), Foreign Direct Investment (fdi), Gross Fixed Capital Formation (gcf), Access to Electricity (ecl), and wage were used as control variables.

The coefficient of inflation rate (inf) is negatively and statistically significant at one percent as expected. The implication is that; inflation has an inverse relationship with the manufacturing output. Specifically, a unit increase in inflation reduced manufacturing output by 0. 688 percent on average, in a year. The result indicates that, over the study period 2004 to 2017, the inflation rate has decreased manufacturing output in SSA by 0. 688 percent, anytime inflation rate increases by one unit. This result would be obvious in a situation where the increase in inflation is coming from an increase in $1(one US dollar) of the general price of domestic manufactured products as a result of the high cost of production. The negative effect of an increase in inflation (an increase in general prices of domestic

manufactured products) decreases the demand for locally manufactured products, holding other factors constant. This result is in line with the study by (Erdal, 1997).

Again, the coefficient for real interest rate (intrat) is negative and highly significant at one percent as expected and could be seen in Table 9 column 2 (RE). This suggests that a high real interest rate negatively affects the manufacturing output of SSA. Precisely, a unit increase in real interest rate would result in a 0. 575 percent reduction in the manufacturing output of SSA on the average. This means that economies with relatively low real interest rates enable manufacturing firms to borrow funds for investment that will improve their productive capacity which is more likely to increase manufacturing output, all things being equal. This result confirms the findings by (Nwandu, 2016; Erdal, 1997) which revealed that the real interest rate has a negative effect on manufacturing sector performance and three-digit manufacturing investment in the French manufacturing sector respectively.

Also, the foreign direct investment (FDI) coefficient in Table 9 column 2 (RE) is positive and statistically insignificant. The intuition is that the net inflows of foreign direct investment into SSA that enters into the manufacturing sector represents a small portion of the total FDI in SSA and therefore, may not influence the SSA manufacturing sector or do not contribute to an increase in the production of manufacturing output. Most of the FDI in SSA goes into the exploitation of natural resources. Since most FDI in SSA are natural resources seekers and are more likely to export these natural resources in their raw form to other industrialized regions which appear to have high prices for raw materials and

production efficiency than SSA, they may be contributing nothing to the manufacturing sector of SSA. A positive sign was expected.

Moreover, the effect of access to electricity (lnecl) on manufacturing output was found to be positive and statistically significant at one percent as expected. The result indicates that, on average, a one percent increase in access to electricity leads to 0.507 percentage higher in manufacturing output of SSA annually, all things being equal. This result supports the study by Mpatane (2015), who indicated that availability and uninterrupted sufficient electricity supply mostly contribute greatly to boosting the manufacturing industry in any economy. Therefore, the expansion of electricity to increase access to the available power supply in any economy is crucial for the manufacturing industry, because it speeds up the production capacity of manufacturing firms and the machinery that needs more electrical energy to function. The effect of access to electricity on the manufacturing output of SSA is most likely to create manufacturing sector employment since the major driver of the modern manufacturing industry is electricity.

Finally, the gross fixed capital formation (GCF) coefficient is positive but not significant in explaining manufacturing output in SSA. The coefficient of wage is negative as expected and statistically insignificant. The intuition is that the wages of manufacturing firms' employees in SSA constitute a small proportion of the total wages of SSA. Hence, wages may not have a strong effect on manufacturing output. Also, there may be the possibility that manufacturing sector output is machinery driven, not labor driven, in other words, manufacturing product is capital intensive

and not labor-intensive, hence wages may not affect manufacturing output negatively.

Table 10: Regression results with the interactive term for objective two

Dependent variable manufacturing output		
Independent variables		
	FE	**RE**
	Coefficients	Coefficient .
Tdop	-0.193 ***	-0.189 ***
	(0.0249308)	(0.024885)
EXCFLU	0.000506 **	0.000527 **
	(0.0002148)	(0.000215)
Inf	-0.00783 ***	-0.00759 ***
	(0.0011591)	(0.001155)
Intrat	-0.00610***	-0.00602 ***
	(0.0010107)	(0.001011)
Fdi	0.0000621	0.0000641
	(0.0001549)	(0.000155)
Gcf	0.00606	0.00729 **
	(0.0033017)	(0.003243)
Lnecl	0.491***	0.503 ***
	(0.06611)	(0.065466)
Wage	0.00967	0.00261
	(0.0080141)	(0.007067)
Ecltrad	0.00141**	0.00124 *
	(0.0006329)	(0.000628)
_cons	18.96 ***	19.10 ***
	(0.2681832)	(0.408899)
R2-overall	0.0807	0.1211
Hausman test ($\chi 2$)		0.73
F test / Wald chi2(9)	554.35 ***	429.81 ***

Note: p < 0.10; * p <0.05; ** p <0.01; *** robust standard errors in parenthesis ()
Source: Ayirikame (2021)

The main variable of interest

From the Hausman test in APPENDIX B, we failed to reject the null hypothesis of no correlation between the regressors and the individual heterogeneity hence, it is clear that the fixed effect is the inappropriate estimator.

We will concentrate on the coefficient under the random effect (RE) in Table 10 for the discussions.

The variables that had a significant effect on manufacturing output are trade openness index, exchange rate fluctuations, inflation rate, real interest rate, gross fixed capital formation, electricity, and the interactive term (trade openness *electricity) in Table 10. The coefficient of trade openness is negative and statistically significant at one percent. This implies that a decrease in trade openness index (reduction in tariffs, reduction in the cost of import and export, a smaller number of days and documentation to complete import and export) increases the manufacturing output. Thus, a unit decrease in the trade openness index may increase manufacturing output by about 18.9% yearly.

However, the coefficient cannot be directly interpreted in Table 10 because of the interaction term (trade openness *electricity). This has to be done with net effect or partial effect of trade openness on manufacturing output as shown in the equation below.

$$\frac{dmfp}{dtdop} = \beta_1 tdop_{it} + \beta_2 elctdop_{it}(mean\ of\ electricity) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (13)$$

Where $\beta_1 tdop_{it}$ the coefficient of trade openness, $\beta_2 elctdop_{it}$ represents the coefficient of the interactive term (trade openness*electricity) and the mean of electricity represents the mean value of access to electricity.

$$\frac{dmfp}{dtdop} = -0.189 + 0.00124(37.60499) = -0.1424$$

The mean value of access to electricity is 37.60499 as seen in Table 7. The result from equation (13) is - 0.1424. This reflects the net effect of trade openness. Hence, it could be argued that when electricity is the control for, a unit increase in trade openness index (high cost of import and export, high tariffs, a greater number of days to complete import and export and a higher number of documentations for import and export), reduced manufacturing output by 14.24 percent in a year, all things being equal. In other words, countries that are more open to international trade (reduction in trade openness index) and a constant uninterrupted electricity supply over the study period increased manufacturing by 14.24% (electricity complement the effect of trade openness on manufacturing output). When compare the coefficient of trade openness index (0.154) without the interaction term with the net coefficient (0.142) of trade openness and electricity interacted. The study found that the coefficient of trade openness is higher than the net coefficient of trade openness when electricity is controlled for. The reason could be associated with the measurement of electricity (access to electricity). When the quantity of electric power (kilowatt) generation remains constant and access to electricity is increased to cover other areas in SSA, it reduces the quantity of electric power supply meant to drive three digits and four digits manufacturing equipment thereby decreasing output produced per hour. Hence, a reduction in trade openness index with access to electricity increases manufacturing output at decreasing rate. This result confirms the positive effects of electricity supply found by (Abraham & Peace, 2015) which stated that electricity is a major component of manufacturing sector productivity and has the potential of doubling manufacturing output. Without

constant and uninterrupted power supply, it will make manufacturing in SSA very expensive thereby causing manufacturers to resort to importation of finished cheaper products and rebrand them for sales because importation is less expensive.

Threshold analysis for objective three

The study used a bootstrap procedure to determine the asymptotic distribution of the F statistic as proposed by Hansen (1999). To determine the number of thresholds, the threshold model allows for sequential estimation; the first estimation was under the hypothesis; H_0: there is no threshold effect, H_1: there is one threshold effect.

Table 11: Test for threshold effect for objective three

Threshold estimated at 95% confidence level		Lower		Upper	
		1.6935		1.7603	
				The critical value of F	
Threshold value	F1	P-value	1%	5%	10%
Single threshold effect test					
1.7597	**16.13**	0.0040 ***	13.7613	11.4176	10.1821
Estimated coefficients Tdop	**0.7608485***** (24.68)				
Threshold estimated at 95% confidence level		Lower		Upper	
		2.4072		2.4955	
				Critical value of F	
Threshold value	F2	P-value	1%	5%	10%
Double threshold effect test					
2.4234	2.07	0.9800	18.7762	14.0971	11.9815

Notes: F-statistics and p-values are from repeating bootstrap procedures 500 times for each of the two bootstrap tests.: p < 0.10; * p <0.05; ** p <0.01; ***, parenthesis () t-statistics, Source: Ayirikame (2021).

The result of the F statistic is tested using the bootstrap distribution of 500 times at a 95% confidence level and the P-value. The study found that the bootstrap p-value is 0.004 which is highly significant and the F statistic is 16.13 at one percent critical value in Table 11. Therefore, the null hypothesis of no threshold effect was rejected and concluded that there is a single threshold effect.

Also, there is the need to determine whether there is another threshold in the data (double threshold). The null hypothesis states that there is a single threshold effect against the alternative hypothesis, there is a double threshold.

The result of F2 statistics is tested using the bootstrap distribution of 500 times at a 95% confidence level and p-value. The study found that the F2 statistic is insignificant with bootstrap p-value 0.9800, hence we failed to reject the null hypothesis of a single threshold and conclude that there is evidence of a single threshold in the regression relationship as seen in Table 11. The estimated single threshold is 1.7597 with a 95% confidence interval (1.6935 to 1.7603) and the F1 statistic is 16.13 at a 1% critical value.

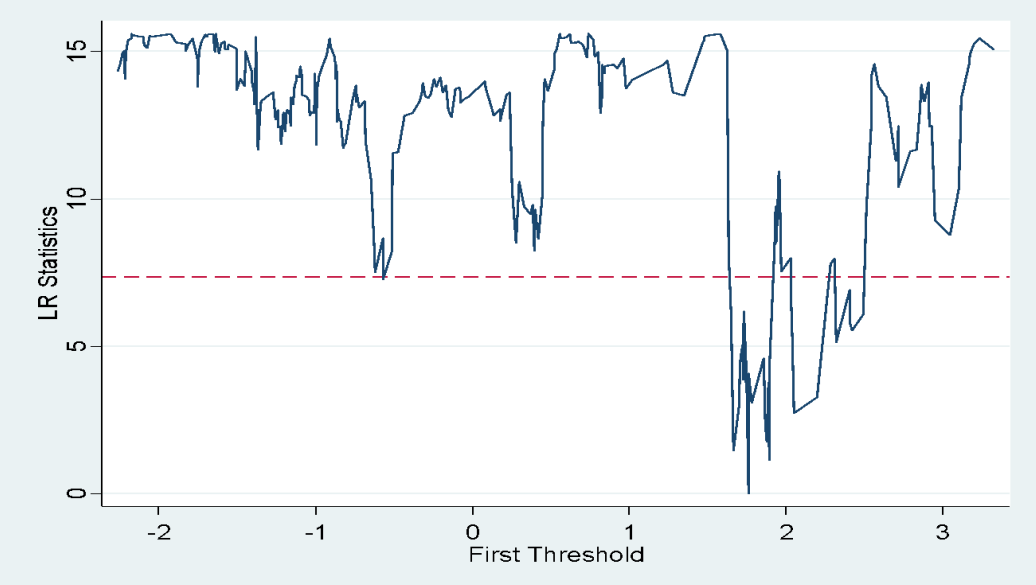

Figure 6. LR statistics of a single threshold
Source: Ayirikame (2021)

Moreover, we can learn more information about the threshold value from the plots of the likelihood ratio test (LR) as shown in Figure 6. The dashed line indicates the critical value (7.35) at the 95% confidence level. The threshold value is found at the point where the likelihood ratio (LR) lies beneath the dotted line, that is, the threshold value occurred at the point where LR is equal to zero (LR = 0). It occurred at **1.7597**.

Table 12: The number of countries in each regime by year

Year	Regime 1: More Openness		Regime 2: less openness	
	qit≤1.7597		qit>1.7597	
2004	15	63%	9	37%
2005	15	63%	9	37%
2006	16	67%	8	33%
2007	17	71%	7	29%
2008	19	79%	5	21%
2009	18	75%	6	25%
2010	19	79%	5	21%
2011	20	83%	4	17%
2012	22	92%	2	8%
2013	22	92%	2	8%
2014	20	83%	4	17%
2015	20	83%	4	17%
2016	20	83%	4	17%
2017	19	79%	5	21%
Total	262	78%	7	22%

Source: Ayirikame (2021).

Table 12, indicates the number and percentage of countries that fall into the two categories yearly. The study found that about 78 percent of SSA countries fall in more openness regime 1 (that is 15 – 19) which shows that most countries in SSA considered in this study have opened trade in their manufacturing sector beyond the threshold value and about 22 percent fall in less openness regime 2 (that is 9 -5). In 2012 and 2013, almost all the countries considered (about 22 countries) were more open to international trade representing 92 percent each year and the lowest in more openness regime1 are in 2004 and 2005 (about 15 countries) representing 63 percent each year. This result confirmed Figure 4 in the introduction section page, where SSA has opened trade with the rest of the world but the manufacturing output continues to decline.

Trade openness index above the threshold value (1.7597) but not beyond the upper bound has a positive effect on the manufacturing output in SSA. This implies that a unit increase in the trade openness index (high cost of import and export, high tariff) leads to about 76 percent higher in manufacturing output annually, holding other factors constant. Meaning, at the threshold value, less open economies to international trade help improve the manufacturing output in SSA. On the other hand, the trade openness index below the threshold value (1.7597) has a negative effect on manufacturing output, which is, a unit decrease in trade openness index (reduction in the cost of import and export, reduction in tariff) may decrease manufacturing output by 76 percent yearly. Therefore, the threshold value is an indication of the point where countries should not open trade beyond this threshold value (1.7597). In other words, the threshold effect means there is a limit to which countries can open for international trade. If countries open up trade beyond the threshold value, it has a detrimental effect on the manufacturing output of SSA.

Opening up the manufacturing sector beyond the threshold value (1.7597) allowed most of the industrialized nations such as Japan, China, the USA, etc. which produced at a relatively cheaper rate due to large scale of production (benefit of economies of scale) to flood SSA economies with their manufacturing products thereby killing the young local manufacturing firms in the region. This result confirms the negative effects of trade openness on SSA manufacturing output found by Akinlo, (2018). The local manufacturers cannot compete with their counterparts in developed countries due to the high cost of production. The high cost of

production has resulted in the deindustrialization of SSA (Grabowski, 2015). Employees are moving from the manufacturing sector into the service sector in a form of retail. That is, they engage in the selling of manufacturing products from industrialized nations that are cheaper as compared to manufactured products from SSA.

This threshold result confirms the findings of Grabowski, (2015) which stated that sub-Saharan Africa is deindustrializing. He argued that SSA is jumping one step that leads to development and structural change. He said economic development is a process - from the Agric sector, you move on to the manufacturing sector before the service sector. However, it appears SSA is jumping from the manufacturing sector to the service sector. We can then infer from Grabowski, (2015) and possibly state that, SSA has opened to international trade beyond a certain limit that has caused the economies to move away from industrialization into rendering services to already existing manufacturing firms from developed nations.

The sum of the two coefficients -0.154 + 0.7608485 = 0.60684. This means that annually, the manufacturing output of SSA declined by 0.606 (61 percent) when the trade openness index goes below the threshold value. When the equation was estimated, the coefficient of trade openness is negatively related to manufacturing output (that is a reduction in trade openness means more openness). It is also statistically significant at 1%, which means, "the more open the manufacturing sector is to international trade, the more manufacturing output increases all things remaining constant" contrary to the threshold analysis. Hence,

this suggests that not taking into account the optimal trade openness effect (threshold effect), trade openness would have detrimental effects on SSA manufacturing output.

In a nutshell, the findings confirm the nonlinear relationship between trade openness and manufacturing output in SSA by identifying the exact turning point of the trade openness index through the use of Hansen's (1999) panel threshold regression model. The result shows that trade openness negatively relates to manufacturing output in SSA (that is, the more openness to trade, the more manufacturing output increases) when trade openness has not reached the threshold value. However, a decrease in the trade openness index below its optimal value of 1.7597(threshold value) as it has been determined by this study is detrimental to the manufacturing output (sector). This result is consistent with the findings by Leyaro, (2015); Mallick, and Behera, (2020); Fatima, Chen, Ramzan, and Abbas, (2020) which stated that trade openness has a threshold effect on GDP growth. The empirical result is consistent with the theory (Hansen,1999) investment decisions.

Results of Sub-Saharan Africa Regional Groupings into Non-Resource Intensive, Non-Oil Exporter and Oil Exporter Countries

Results for the non-resource intensive, non-oil exporter and oil exporter were estimated from the fixed effect and random effect equation (11). That is, each panel equation contains a member grouping under the International Monetary Fund 2019 report, titled; *Regional Economic Outlook, SSA, Recovery Amid Elevated Uncertainty*. The appendices C to E indicates the results of the Hausman test for the various groupings (non-resource intensive, non-oil, and oil exporter).

The Hausman test fails to reject the null hypotheses of no correlation between the regressors and individual heterogeneity hence rendered the fixed effect inappropriate for the analysis for Non-resource intensive and non-oil exporters estimations. While the Hausman test for oil exporters estimation rejects the null hypothesis, which indicates that the random effect is not appropriate. We used the coefficients estimated under the random effect in Tables 13 and 14, for the analysis of non-resource intensive and non-oil exporters respectively. Also, the coefficients for the fixed effect in Table 15 are used in the analysis for oil exporters.

Non-Resource Intensive

Table 13: Regression results from fixed and random effect for non-resource countries

Dependent variable manufacturing output		
Independent variables	**Non-Resource Intensive**	
	FE	**RE**
	Coeff	coeff
Tdop	-0.177 ***	-0.176 ***
	(0.025759)	(0.025726)
EXCFLU	0.000747 *	0.000756 **
	(0.000292)	(0.000292)
Inf	-0.00703 ***	-0.00693 ***
	(0.001339)	(0.001336)
Intrat	-0.00591 ***	-0.00591 ***
	(0.001146)	(0.001148)
Fdi	2.04E-05	1.43E-05
	(0.000197)	(0.000197)
Gcf	0.00342	0.00405
	(0.005763)	(0.005718)
Lnecl	0.457 ***	0.457 ***
	(0.09024)	(0.089539)
Wage	-0.00612	-0.00773
	(0.009871)	(0.008745)
_cons	19.38 ***	19.42 ***
	(0.424757)	(0.578571)
Hausman test ($\chi 2$)	0.75	
N	210	210
R-Squared	0.0881	0.0914

Note: p < 0.10; * p <0.05; ** p <0.01; *** robust standard errors in parenthesis ()
Source: Ayirikame (2021).

Main variables of interest

The coefficients for trade openness and exchange rate fluctuations which are the main variables of interest were estimated in Table 13 column 2 (RE) as suggested by the Hausman test in APPENDIX C.

The variable trade openness index was estimated to be negative and significant at one percent as expected. The negative relationship means that, as stated earlier, countries with high import and export costs, a higher number of days to complete import and export, a lot of paperwork to complete import or export, and a high tariff rate reduced manufacturing output in their economies. More concisely, a unit increase in trade openness index will decrease manufacturing output by about 17.6 percent annually, all other things remaining constant. This means that trade openness is important to non-resource-intensive countries to boost their manufacturing sector output. Non-resource countries can increase their manufacturing output by reducing the trade openness index. This finding is in line with theory and empirical studies by (Ramondo, Rodríguez-clare, Journal, & April 2013) which stated that trade openness (traditional trade openness (export plus import /GDP) has positive gains, as less endowed nations import intermediate input for further production.

Exchange rate fluctuations which were also another variable of interest are positive and statistically significant at five percent (5%)s. Thus, over the period of the study 2004 to 2017, a unit increase in exchange rate fluctuations would lead to about a 0.076 percent increase in manufacturing output ceteris paribus. A positive sign was expected in a situation where exports become cheaper as a result of a depreciation of the currency. In this case, non-resource intensive countries are expected to import most of their raw materials and machinery to feed their manufacturing industries to produce for export. On the other hand, during the appreciation of the currency, export has a negative effect on manufacturing output.

Therefore, as exchange rate fluctuations increase, the non-resource intensive manufacturing output increases ceteris paribus. This result confirms the study by Mijiyawa, (2017) which stated that exchange rate depreciation boosts the manufacturing industry performance in SSA.

Control variables for non-resource intensive

The inflation rate and real interest rate in non-resource intensive countries are expected are both statistically significant at one percent and have a negative effect on manufacturing output. Thus, all things being equal, a unit increase in the inflation rate decreases the manufacturing output of non-resource intensive countries by 0.69 percent. Again, a unit decrease in real interest would lead to about 0.59 percent increase in manufacturing output of non-resource intensive countries in SSA, all other things remaining constant. These findings confirm the study by Akinlo, 2018 which stated that inflation and interest have a negative effect on SSA manufacturing performance.

The electricity variable was estimated to be positive and statistically significant at one percent. A percentage increase in access to electricity leads to about 0.46 percentage increase in manufacturing output of non-resource intensive countries, all things being constant. This is in line with the study by Abraham & Peace, (2015). However, foreign direct investment (FDI), gross fixed capital formation, and wage were statistically insignificant but have their expected signs. Intuitively, most FDI that comes into SSA are resource seekers hence, less or non-resource intensive countries are less likely to attract FDI into their economies. The FDI that flows into a non-resource-intensive manufacturing sector represents a

small proportion of the total FDI inflow into SSA. The FDI in non-resource intensive countries may not have any strong effect on the manufacturing sector that could influence manufacturing output positively.

Non-oil exporter

Table 14: Regression results from fixed and random effect for non-oil exporter countries

Dependent variable manufacturing output		
	Non-oil exporter	
Independent variables	FE	**RE**
	Coeff	Coeff
Tdop	-0.139 ***	-0.139 ***
	(0.01738)	(0.017322)
EXCFLU	0.000504 **	0.000512 **
	(0.000177)	(0.000177)
Inf	-0.00621 ***	-0.00616 ***
	(0.000959)	(0.000957)
Intrat	-0.00394 *	-0.00409 **
	(0.002049)	(0.002043)
Fdi	0.000606 **	0.000605 **
	(0.000243)	(0.000242)
Gcf	0.0149 ***	0.0157 ***
	(0.00306)	(0.003015)
Lnecl	0.404 ***	0.410 ***
	(0.055142)	(0.054703)
Wage	0.0176 **	0.0134 **
	(0.006949)	(0.006425)
_cons	18.55 ***	18.64 ***
	(0.22654)	(0.438378)
Hausman test (χ^2)	2.77	
N	266	266
R-Squared	0.0719	0.0894

Note: p < 0.10; * p <0.05; ** p <0.01; *** robust standard errors in parenthesis ()
Source: Ayirikame (2021).

Main variables of interest for the non-oil exporter

Per the Hausman test in APPENDIX D, the coefficients under the random effect (RE) in Table 14 are considered in the analysis. As expected, trade openness has a negative sign and it is statistically significant at one percent (1%). The trade

openness index has an inverse relationship with the manufacturing output of non-oil exporters. This means that a unit reduction in trade openness index (reduction in tariffs on import and export, low import, and export cost in the manufacturing sector) would increase the manufacturing output of non-oil exporter countries by 13.9 percent annually, ceteris paribus. This result would be more pronounced if the reduction in trade openness index is coming from the reduction in tariffs of locally manufactured goods, low import, and export cost of manufactured inputs and output respectively. Theoretically, the results are in line with theory and consistent with the argument leveled by empirical studies that trade provides access to investments and intermediate goods for further production in the manufacturing sector (Mushtaq et al., 2014; Nketiah, Cai, Adjei, & Boamah, 2020).

Again, the variable exchange rate fluctuations are positive and had a significant effect on manufacturing output at 5 percent as expected (5%). The implication is that there is a 0.512 percent increase in the manufacturing output of non-oil exporters given one additional unit increase in exchange rate fluctuations, ceteris paribus. It has been argued that depreciation of the currencies of non-oil exporters' countries helps improve the manufacturing sector, only if their economies are export-oriented. This result is contrary to the findings by Nonejad & Mohammadi, (2016) which stated that exchange rate fluctuations have a negative effect on manufacturing GDP while Lawal's, (2016) arguments are consistent with the findings in this study.

Control Variables of the Non-Oil Exporters

The inflation rate and real interest rate were estimated to have a significant negative impact on the manufacturing output of non-oil exporter countries. The inflation rate is statistically significant at one percent and the real interest rate has been statistically significant at 5 percent. Ceteris paribus, a one-unit increase in the inflation rate would lead to a 0.616 percent decrease in manufacturing output of non-oil exporters in SSA. Also, as the real interest rate increases by one unit, it will lead to a 0.41 percent decrease in manufacturing output of non-oil exporter countries in SSA, all things being constant.

The variables, foreign direct investment (FDI), gross fixed capital formation (GCF), log of access to electricity (LNECL), and wage rate were estimated to have positive signs on the manufacturing output of non-oil exporters. The result showed that all things being equal, a unit increase in FDI, GCF, and wage rate would lead to about 0.061%, 1.57%, and 1.34% increase in manufacturing output of non-oil exporter countries at a significant level of 5%, 1%, and 5% respectively. Again, a one percent increase in the log of access to electricity would increase the manufacturing output of non-oil exporter countries by 0.41 percent annually, all other things constant. This is consistent with the findings of Mpatane, (2015).

The variable wage was found to have a positive sign contrary to what was expected. By intuition, higher wages in the manufacturing sector attract high skilled labor which enables manufacturing firms to produce high-quality products and improve productivity leading to an increase in manufacturing output. Some recent

studies such as Gunay et al., (2006) have found a positive relationship between wage and manufacturing output.

Additionally, FDI and GCF have not been significant in explaining manufacturing output in all the models except for non-oil exporter countries' models. This tells us how important FDI and GCF are, to the economies of non-oil exporter countries. Since they lack the natural resource called oil, they concentrated their effort on other opportunities available such as the manufacturing sector development to attract FDI into the sector. Also, the FDI that comes into non-oil exporter countries sees the attractiveness of the manufacturing sector since investors aim at high-profit ventures to invest. Hence, they invest in the manufacturing sector which by implication has a significant positive impact on the manufacturing output of non-oil exporters. Furthermore, the gross fixed capital formation of the non-oil exporter is purposely used to facilitate the manufacturing sector growth (governments undertake projects in the manufacturing sector by constructing good roads to link manufacturing firms, new factory buildings, port and harbor (social overhead capital in the manufacturing sector). These explain the positive significant impact GCF has on the manufacturing output of non-oil exporters in SSA

Oil Exporters

The Hausman test in Appendix E shows that the fixed effect is appropriate. We will use the coefficients under the fixed effect in table 14 column 1 (FE) for the analysis.

Table 15: Regression results from fixed and random effect for oil exporter countries

Dependent variable manufacturing output		
Independent variables	**Oil Exporters**	
	FE	RE
	Coeff	coeff
Tdop	-0.0836	-0.233 **
	(0.050621)	(0.085035)
EXCFLU	0.0011	0.00661 *
	(0.001504)	(0.003248)
Inf	-0.00565	0.00142
	(0.004582)	(0.009356)
Intrat	-0.00505 **	-0.00853 **
	(0.001553)	(0.003281)
Fdi	0.000154	0.000347
	(0.000252)	(0.000545)
Gcf	-0.016	-0.0245
	(0.008106)	(0.017944)
Lnecl	1.541 **	-1.861 ***
	(0.458238)	(0.495731)
Wage	-0.0724 **	-0.0475 ***
	(0.025049)	(0.008017)
_cons	18.37 ***	31.26 ***
	(2.009721)	(1.976743)
Hausman test (χ^2)	151.42 ***	
N	70	70
R-squared	0.5145	0.7827

Note: p < 0.10; * p <0.05; ** p <0.01; *** robust standard errors in parenthesis ()
Source: Ayirikame (2021).

The main Variables of interest for an Oil Exporter

The variables of trade openness and exchange rate fluctuations which are the main issues of interest in Table 15 column 1 (FE) are statistically insignificant but have their expected sign. This implies that trade openness and exchange rate fluctuations do not have a significant impact on the manufacturing output of oil exporter countries. Meaning, ever since the oil sector in the oil-exporting countries became drivers of growth, the oil sector enjoyed fairly well-established institutional settings like education, financial, labor market and public infrastructure. Hence, it is likely that trade openness and exchange rate fluctuations have not contributed to manufacturing output growth in oil-exporting countries. Intuitively, there is what we call Dutch Disease in the oil-exporting countries as shown by the insignificant effect of the trade openness index and exchange rate fluctuations on the manufacturing sector. This study contributes to the Dutch Disease literature where many countries that are rich in oil resources neglect the other sectors of the economy (Adeleke & Studies, 2014).

Also, there is the possibility that most of the trade openness policies and exchange rate fluctuations may be gearing towards the oil sector neglecting the manufacturing sector (Edo, 2013). This is because changes in trade openness and exchange rate fluctuations are more likely to lead to an increase in the export of oil rather than manufacturing output. This result confirms the study on Dutch disease (Adeleke & Studies, 2014) where a country discovers oil and abandons all other sectors such as the Agric sector and the manufacturing sector.

Control Variables for an Oil Exporter

Real interest rates and wages were estimated to have a negative significant effect on the manufacturing output of oil exporter countries at 5%. The results indicate that a unit increase in the real interest rate and wage respectively leads to a 0.51 percent and 7.24 percent decrease in manufacturing output of oil-exporting countries in SSA, Ceteris paribus. This result is in line with the argument by Ehikioya & Ismaila, (2014). Again, a percentage increase in access to electricity will increase the manufacturing output of oil-exporting countries by 1.54 percent annually, all things being constant.

However, the variables inflation rate, FDI, and gross fixed capital formation were insignificant in explaining the manufacturing output in oil-exporting countries. Inflation rate and FDI respectively have negative and positive signs as expected but gross fixed capital formation has a negative sign which is inconsistent with the expected sign as explained by the theory. Moreover, the intuition behind the insignificant inflation rate and FDI is that most of the increase in the general price level in oil-exporting countries might come from the oil sector which may not have a direct effect on the manufacturing sector. The inflation rate may have an indirect impact on manufacturing through the transportation sector due to high fuel prices. Also, FDI has no significant effect on the manufacturing output of oil-exporting countries. This is a reflection of the inability of oil-exporting countries to attract FDI into their manufacturing sector and the fact that many FDIare interested in the exploitation of oil which is raw material other than manufacturing products.

It goes on to confirm that most FDIs in SSA are resource seekers (raw materials seekers) (Cinar & Aboubakary, 2018; Beverelli & Erba, 2011).

Conclusion

Chapter four discussed the fixed effect and random effect estimation techniques that were used to examine the effect of trade openness and exchange rate fluctuations on the manufacturing output in SSA. It has been found that the trade openness index had a negative significant impact on manufacturing output and exchange rate fluctuations had a positive significant effect on manufacturing output in SSA. A test for threshold effect of trade openness proof a positive significant effect on manufacturing output in SSA.

CHAPTER FIVE

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Introduction

This final chapter presents the summary, conclusions, and further provides policy directions (recommendations). The summary provides a brief overview of the study which includes the research problem, the objectives of the study, methodology, and research findings. The conclusions present the overall outcome of the findings based on the stated hypothesis. The recommendations provide policy direction for implementation by specific bodies. This chapter further presents the direction for future research.

Summary

The manufacturing sector industrialization has always been a major objective of every government. Through industrialization, developing nations seek to achieve high economic growth. Trade openness and exchange rate fluctuations on economic growth have been largely investigated by most researchers. Most of these studies have been either, to examine the effect of trade openness and economic growth or to examine the effect of exchange rate fluctuations on manufacturing sector performance (Mireku, 2017; Keho, 2017; Akinlo,2018). Amidst these several studies, it's important to note that, sector disaggregation of the effect of trade openness is inconclusive, that is, the effect of trade openness on manufacturing output. It is also worth mentioning that variables used in previous studies had issues with measurement errors. More importantly, other studies did not

consider the threshold effect of trade openness on manufacturing output in SSA. Hence, they have records of inconclusive results. Thus, while some researchers found an insignificant effect, others have found a positive or negative effect. Therefore, many scholars remain uncertain whether the approaches of trade openness policies and exchange rate fluctuations policies have indeed been successful in transforming the manufacturing sector of SSA. This creates difficulty for policymakers to manipulate policies to achieve the main objective of sustained industrial growth in the manufacturing sector of SSA.

The objectives of the study were to examine the effects of trade openness and exchange rate fluctuations on manufacturing output, the interaction effects of trade openness and electricity on manufacturing output, the optimal level of trade openness (threshold effect) and manufacturing output as well as examine the effects of trade openness and exchange rate fluctuations on manufacturing output across non-resource intensive, non-oil exporter and oil exporter countries.

The study estimated a balanced panel model with data from World Bank Development Indicators as well as World Bank Doing Business Indicators. The trade openness was captured as an index. The Principal Component Analysis (PCA) was used to generate a trade openness index while exchange rate fluctuations were captured as the differences in the yearly average exchange rate of each country. The fixed effect and random effect methods of estimation were used to estimate the effect of trade openness and exchange rate fluctuations on manufacturing output in SSA.

The Hausman test was used to choose between a fixed effect and a random effect. The Hausman test failed to reject the null hypothesis of no correlation between the unobserved heterogeneity and the explanatory variables for the first and second estimation. Therefore, suggesting that, the estimated coefficients from the random effect are preferred over the fixed effect. In addition, the Hansen, (1999) bootstrap test for the threshold effect was used to test the threshold value for the trade openness index. The last estimation across groupings (non-resource intensive, non-oil exporter, and oil exporter countries). The Hausman test failed to reject the null hypothesis of no correlation between the unobserved heterogeneity and the independent variables for the estimates of non-resource intensive and non-oil exporter rendering the fixed effect inappropriate estimator. The random effect estimator was used for the analysis. The Hausman test for oil exporter countries rejects the null hypothesis of no correlation between the unobserved heterogeneity and the independent variables indicate that the fixed effect estimator is preferred over the random effect estimator. Serial correlation and heteroskedasticity were checked by conducting robust estimation.

The findings revealed that less open economies to international trade had a negative effect on the manufacturing output in SSA. Exchange rate fluctuations had a positive effect on the manufacturing output for countries that export manufacturing output and negative effects for countries that import manufacturing output. The exchange rate fluctuations in SSA depend on the overriding effect of demand and supply of manufacturing output. Also, more open economies to international trade and the constant supply of electricity increase manufacturing

output significantly in SSA. The trade openness index had a threshold effect on the manufacturing output of SSA. For respective groupings, the trade openness index was estimated to have a significant negative effect on non-resource intensive and non-oil exporter countries but not significant for oil exporter countries. Moreover, exchange rate fluctuations were estimated to have a positive significant effect on the manufacturing output of non-resource intensive and non-oil exporter countries but an insignificant effect for oil exporter countries.

Conclusions

The following conclusions are drawn from the findings. Empirical evidence from this study brought to light the following;

- The openness to international trade help increases the manufacturing output in SSA. Again, exchange rate fluctuations were the only beneficiary to manufacturing firms that export their product.
- Evidence from the empirical study also shows that the intermediating effect of trade openness and access to electricity has significantly increased the manufacturing output of SSA as compared to the period where access to electricity was difficult.
- The threshold effect of trade openness from the empirical findings indicates that the trade openness index has a significant and positive effect on the manufacturing output at the threshold value of 1.7597 in SSA. At the threshold value (1.7597), less openness of the manufacturing sector to international trade increased the manufacturing output. Therefore, trade openness above the threshold value of **1.7597** contributes relatively more to

manufacturing sector output than trade openness below the threshold value of **1.7597** (limited liberalization).

- The empirical evidence across groupings shows that manufacturing output from non-resource intensive countries and non-oil exporter countries have significantly increased as a result of greater openness of their manufacturing sector to international trade. The trade openness index has a significant inverse effect on the manufacturing output of non-resource intensive and non-oil exporter countries but not significant for oil-exporting countries' manufacturing output. Also, exchange rate fluctuations have a significant positive effect on the manufacturing output of non-resource intensive and non-oil exporter countries. Exchange rate fluctuations are seen not to have any significant effect on the manufacturing output of oil-exporting countries. From the study, two observations are made from the exchange rate fluctuations in SSA;
    - Exchange rate depreciations increased manufacturing output for economies that export manufactured products
    - Exchange rate appreciation increased manufacturing output for economies that import intermediates inputs for further productions.
- The inflation rate reduces manufacturing output in SSA, non- resource-intensive, and non-oil exporting countries. However, the inflation rate is seen not to have any significant effect on the manufacturing output of oil-exporting countries.

- Also, the real interest rate was recorded to have a significant effect on the manufacturing output of SSA, non-resource intensive, non-oil exporter, and oil exporter countries. Again, foreign direct investment and gross fixed capital formation were only seen to have a positive significance on the manufacturing output of non-oil exporting countries but not significant in SSA, non-resource intensive, and oil-exporting countries.
- Electricity complement trade openness to increases manufacturing output in SSA. In addition, the wage rate has a significant positive effect on the manufacturing output of non-oil exporter countries but a significant negative effect on oil-exporting countries' manufacturing output. However, the wage rate has no significant effect on the manufacturing output of non-resource intensive and SSA as a whole.

Recommendations

The following recommendations are suggested based on the key findings of this study.

I. Firstly, the study proves that less openness to international trade affects SSA manufacturing output negatively. It also proves that exchange rate fluctuations impact SSA manufacturing output positively. Hence, there is the need for countries in SSA to work harder through the Ministry of Trade and Industry of their various countries to improve the business environments by reducing tariffs on import and export, reducing export and import costs of the manufacturing sector. More importantly, manufacturing firms in SSA are encouraged to put up modern facilities and equipment that

enhance technological adoption, productive efficiency, technical and managerial assistance as they interact with industrialized nations. Furthermore, the SSA manufacturing industry is still growing and can not compete with developed countries' manufacturing industries. Therefore, SSA countries should endeavor to implement limited liberalization in the manufacturing sector. Openness to international trade should only be encouraged if such policies promote the exportation of manufacturing output. Also, because exchange rate fluctuations result in uncertainty of the macroeconomic environment and hinder optimal investment (irreversibility and waiting for new information). Hence, governments and central banks should enact policies such as managed floating, Central banks interventions that aim at stabilizing the exchange rate and also promote the exportation of manufacturing output. Also, governments should take advantage of the constant depreciation of the currency and undertake purposive investment in the manufacturing sector for export.

II. Secondly, access to electricity is an intermediating factor that promotes manufacturing output in SSA. Therefore, investment in the electricity sector should be increased to cover all parts of SSA. Also, governments should consider increasing electricity power generation to make constant and uninterrupted power supply available to manufacturing firms and boost their production.

III. Thirdly, emphasis should be shifted from more openness of international trade to the level at which the manufacturing sector should be exposed to

international trade. This is because, at the threshold value, more openness to international trade is detrimental to SSA manufacturing output. The threshold value of **1.7597** suggests that at this **175.97%** of the trade openness index, the manufacturing sector of SSA should be protected. It is, therefore, necessary for governments and the ministry of trade and industry to provide policies and programs that target SSA manufacturing sector protections (embark on limitation liberalization). This provides an enabling environment for the SSA manufacturing sector to thrive.

IV. Lastly, non-resources intensive and non-oil exporting countries in SSA stand to benefit from higher openness to international trade. We recommend that governments in non Resources and non-Oil exporting countries should adopt policies that target subsidizing the import of plants and machinery or intermediate input (raw materials) to ensure higher productivity.

Direction for Future Research

Future research can consider a similar analysis in other sectors of the economy by exploring the effects of trade openness and exchange rate fluctuations on the agricultural sector.

Also, studies that use export plus import / GDP as a proxy for trade openness tell a different story from those that use PCA to generate a trade openness index. Thus, earlier studies on trade openness and economic growth can be replicated simply by changing the proxy for trade openness since the expected results will be unique.

REFERENCES

Abdul-mumuni, A. (2016). *Exchange Rate Variability and Manufacturing Sector Performance in Ghana : Evidence from Cointegration Analysis*. 1–14.

Abeberese, A. B., Ackah, C., & Asuming, P. (2017). *Productivity Losses and Firm Responses to Electricity Shortages : Evidence from Ghana*. (December). Retrieved from https://www.theigc.org/wp/content/uploads/2018/06/ Abeberese-et-al-2017-Working-paper.pdf

Aboubacar, B., Xu, D., & Ousseini, A. M. (2014). *Does Trade Openness Matter for Economic Growth in Niger* (December), 916–927.

Achouak, A., Ben-Salha, O., & Zmami, M. (2018). Exchange rate volatility and economic growth. Journal of Economic Integration, 33(2), 1302-1336.

Ackah, C., Adjasi, C., & Turkson, F. (2014). *Scoping Study on the Evolution of Industry in Ghana*. (1).

Adam B. Elhiraika, Ousman Aboubakar, and Kamaludeen Muhammad (2014) Promoting Manufacturing to Accelerate Economic Growth and Reduce: *The Journal of Developing Areas. 48, No . 2 1-20 48*(2), 1–20.

Omolade, A. (2014). Monetary policy and manufacturing sector growth in Africa's oil-exporting countries (Unpublished doctoral dissertation). The *University of KwaZulu-Natal*.

Adewuyi, A. O., & Akpokodje, G. (2013). Exchange rate volatility and economic activities of Africa's sub-groups. *The International Trade Journal*, *27*(4), 349-384.

Afaha, J. S., & Oluwatobi, A. O. (2012). Foreign trade and economic growth: Evidence from Nigeria. *Oman Chapter of Arabian Journal of Business and Management Review*, *34*(970), 1-23.

African Development Bank (2019) Industrialise Africa. Retrieved from: https://www.afdb.org/en/the-high-5/industrialize-africa

African Union (2015) Agenda 2063. Retrieved from: https://en.wikipedia.org/wiki/Agenda_2063

Aghevli, B. B., Khan, M. S., & Montiel, P. (1991). *Exchange rate policy in developing countries: some analytical issues* (Vol. 78). International monetary fund.

Akinlo, T. (2018). *The impact of exchange rate volatility on the manufacturing sector*. *6*(1), 59–68.

Alagidede, P., & Ibrahim, M. (2017). On the Causes and Effects of Exchange Rate Volatility on Economic Growth: Evidence from Ghana. *Journal of African Business*, *18*(2), 169–193.

Antonelli, C. (2014). The economics of innovation, new technologies, and structural change. In *The Economics of Innovation, New Technologies, and Structural Change*. Routledge.

Avila, N., Carvallo, J., Shaw, B., & Kammen, D. M. (2017). The energy challenge in sub-Saharan Africa: Generating energy for sustainable and equitable development. *Oxfam Research Backgrounder Series*, 100. Retrieved from https://www.oxfamamerica.org/static/media/files/oxfam-Rael-energy SSA-pt1.pdf

Beverelli, C., Dell'Erba, S., & Rocha, N. (2011). Dutch disease revisited. Oil discoveries and movements of the real exchange rate when manufacturing is resource-intensive. *International Economics and Economic Policy*, *8*(2), 139-153.

Bhorat, H., Kanbur, R., Rooney, C., & Steenkamp, F. (2017). *Sub-Saharan Africa's Manufacturing Sector : Building Complexity*.

Blimpo, M. P., & Cosgrove-Davies, M. (2019). Electricity Access in Sub-Saharan Africa: Uptake, Reliability, and Complementary Factors for Economic Impact. In *Electricity Access in Sub-Saharan Africa: Uptake, Reliability, and Complementary Factors for Economic Impact*.

Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, *87*(1), 115-143.

Bornhorst, F., & Baum, C. (2006). LEVINLIN: Stata module to perform Levin-Lin-Chu panel unit root test. Econpapers, RePEc.

Bornhorst, F., & Baum, C. (2007). IPSHIN: Stata module to perform Im-Pesaran-Shin panel unit root test.

Cantah, W. G., Insaidoo, G. W., Agyapong, E., & Adams, A. (2016). *FDI and Trade Policy Openness in Sub-Saharan Africa*. 1–20. *Eastern Economic Journal*.

Chairman of the Massive Online Course (2018) lectures, Maselli. Retrieved from:https://www.wider.unu.edu/publication/rethinking-african-industrialization-another-africa-industrialization-day

Chandran, V. G. R. (2009). *Trade openness and manufacturing growth in Malaysia*. *31*, 637–647. *Journal of Policy Modeling*, *31*(5), 637-647.

Chatterjee, A., Dix-Carneiro, R., & Vichyanond, J. (2013). Multi-product firms and exchange rate fluctuations. *American Economic Journal: Economic Policy*, *5*(2), 77-110.

Cinar, M., & Aboubakary, N. (2018). Foreign Direct Investment, Trade Openness, and Economic Growth *: Panel Data Analysis for Sub-Saharan Africa*. *9*(4), 749–760.

Das, A., & Paul, B. (2011). *Openness and Growth in Emerging Asian Economies : Evidence From GMM Estimations of a Dynamic Panel Volume 31, Issue 3 Openness and growth in emerging Asian economies : Evidence from GMM estimations of a dynamic panel*. (September).

Dhasmana, A. (2013). Real effective exchange rate and manufacturing sector performance: evidence from Indian firms. *IIM Bangalore Research Paper*, (412).

Dinh, H. T., Palmade, V., Chandra, V., & Cossar, F. (2012). *Light manufacturing in Africa: Targeted policies to enhance private investment and create jobs*. The World Bank.

Divyasree-PP. (2015). *Impact Of Exchange Rate Intervention And Trade Openness On The Economy Of Brics*. (Doctoral Dissertation).

Dobre, C. (2008). The relation between openness to trade and economic growth. *Analele Ştiinţifice ale Universităţii» Alexandru Ioan Cuza «din Iaşi. Ştiinţe economice*, (55), 237-247.

Edo, S. E. (2013). Crude oil discovery and exploitation: the bane of manufacturing sector development in an oil-rich country, Nigeria. *OPEC Energy Review*, *37*(1), 105-124.

Edwards, B. S. (1993). *Openness, Trade Liberalization, and Growth in Developing Countries*. *31*(3), 1358–1393.

Edwards, S., & Magendzo, I. I. (2003). *Strict dollarization and economic performance: An empirical investigation* (No. w9820). National Bureau of Economic Research.

Effiong, E. L. & Ekong, C. N. (2015). Oil price shocks and Nigeria's macroeconomy: Disentangling the dynamics of crude oil market shocks. *Global Business Review*, *16*(6), 920-935.

Ehikioya, L., & Ismaila. (2014). *Empirical Investigation of the Impact of Monetary Policy on Manufacturing Sector Performance In By*. *2*(1), 1–20.

Ehinomen, C., & Oladipo, T. I. (2012). Exchange Rate Management and the Manufacturing Sector Performance in the Nigerian Economy. Iosrjournals.Org *5*(5), 1–12.

Elhiraika, A. B., Aboubakar, O., & Muhammad, K. (2014). Promoting manufacturing to accelerate economic growth and reduce growth volatility in Africa. *The Journal of Developing Areas*, 1-20.

Erdal, B. (1997). *The Effects of Real Exchange Rate Volatility on Sectoral* (Routledge). 2 Park Square, Milton Park, Abingdon, Oxon Ox14 4rn: Taylor and Francis.

Fatima, S., Chen, B., Ramzan, M., & Abbas, Q. (2020). The Nexus Between Trade Openness and GDP Growth: Analyzing the Role of Human Capital Accumulation. *SAGE Open*, *10*(4)

Fetene, Hunegnaw, B. (2017). Real exchange rate and manufacturing export competitiveness in Eastern Africa. *Journal of Economic Integration*, 891-912.

Fischer, S., & Modigliani, F. (1978). Towards an understanding of the real effects and costs of inflation. *Review of World Economics*, *114*(4), 810-833.

Grabowski, R. (2015). Deindustrialization in Africa. *International Journal of African Development*, *3*(1), 5.

Greene, W. H. (2008). The econometric approach to efficiency analysis. *The measurement of productive efficiency and productivity growth*, *1*(1), 92-250.

Grossman, G. M., & Helpman, E. (1991). *Trade, knowledge spillovers, and growth *. 35*.

Gunay, A., Metin-ozcan, K., Yeldan, E., Gunay, A., Metin-ozcan, K., & Yeldan, E. (2006). *Real wages, profit margins, and inflation in Turkish manufacturing under post-liberalization Real wages, profit margins, and inflation in Turkish manufacturing under post-liberalization*. *6846*.

Hansen, B. E. (1999). *Threshold e ! acts in non-dynamic panels : Estimation, testing, and inference*. *93*.

Hausman, J. A. (1978). Specification tests in econometrics. *Econometrica: Journal of the econometric society*, 1251-1271.

Hye, Q. M. A., Lau, W. Y., & Tourres, M. A. (2014). Does economic liberalization promote economic growth in Pakistan? An empirical analysis. *Quality and Quantity*, *48*(4), 2097–2119.

International Monetary Fund (2019). *Regional Economic Outlook. Sub-Saharan Africa: Recovery Amid Elevated Uncertainty*. Washington DC (U.S.A.)

John. (2016). Reversing Africa's Industrial Decline: Some Ideas from Learning to compete Ending Up Where it Started Africa has deindustrialized since 1980.

Kandil, M., & Dincer, N. N. (2008). A comparative analysis of exchange rate fluctuations and economic activity. *International Journal of Development Issues. The cases of Egypt and Turkey*.

Keho, Y. (2017). The impact of trade openness on economic growth : The case of Cote d ' Ivoire. *Cogent Economics & Finance*, *8*(1), 1–14.

Levchenko, A. A., Giovanni, J., & Levchenko, A. A. (2019). *Trade Openness and Volatility Macroeconomic volatility is considered an im*. *91*(3), 558–585.

Levin, A., Lin, C. F., & Chu, C. S. J. (2002). Unit root tests in panel data: asymptotic and finite-sample properties. *Journal of econometrics*, *108*(1), 1-24.

Leyaro, V. (2015). *Threshold and interaction effects in the trade, growth, and inequality relationship* (No. 2015/009). WIDER Working Paper.

Mallick, L., & Behera, S. R. (2020). Does trade openness affect economic growth in India? Evidence from threshold cointegration with asymmetric adjustment. *Cogent Economics & Finance*, *8*(1), 1782659.

Mendes, A. P. F., Bertella, M. A., & Teixeira, R. F. (2014). Industrialization in Sub-Saharan Africa and import substitution policy. *Brazilian Journal of Political Economy*, *34*(1), 120-138.

Mijiyawa, A. G. (2017). Drivers of Structural Transformation : The Case of the Manufacturing Sector in Africa. *World Development*, *99*, 141–159.

Mireku, K., Agyei, E. A., & Domeher, D. (2017). Trade openness and economic growth volatility : An empirical investigation. *Cogent in Economics & Finance*, *25*.

Mohammed, A. J. (2018). The Africa we want. *Our Planet*, *2016*(2), 14–17.

Mpatane, L. M. (2015). The impact of electricity supply on the manufacturing sector output in South Africa (Doctoral dissertation).

Mushtaq, M., Nazir, R., Ahmed, S., & Nadeem, M. (2014). *Trade Openness - Manufacturing Output Nexus : A Panel Data Study*. *261*(March), 256–261.

N'da, K. C. (2012). The Cost of Doing Business in Sub-Saharan Africa Bridges Africa. *International Center for Trade and Sustainable Development*, *1*(6).

Nketiah, E., Cai, X., Adjei, M., & Boamah, B. B. (2019). *Foreign Direct Investment, Trade Openness, and Economic Growth : Evidence from Ghana*. 39–55.

Nonejad, M., & Mohammadi, M. (2016). *The Effect of Exchange Rate Fluctuation on Economic Activities of Iran*. 353–365.

Nwandu, E. (2016). *Impact of Rising Interest Rate on the Performances of the Nigerian Manufacturing Sector Percentage of Manufacturing Sector in*. *8*(10), 125–134.

Ojo, A. T., & Alege, P. O. (2014). *Exchange Rate Fluctuations And Macroeconomic Performance In Sub-Saharan Africa : A Dynamic Panel Cointegration Analysis Contribution / Originality*. *4*(11), 1573–1591.

Omotola, Lawal, E. (2016). Effect of Exchange Rate Fluctuations on Manufacturing Sector Output in Nigeria. *Quest Journals, Journal of Research in Business and Management*, *4*(10), 32–39.

Ramondo, N., Rodríguez-clare, A., Journal, S., & April, N. (2013). *Trade, Multinational Production, and the Gains from Openness Trade, Multinational Production, and the Gains from Openness Natalia Ramondo ′ s Rodrı*. *121*(2), 273–322.

Rodrik, D. (2014). The past, present, and future of economic growth. *Challenge*, *57*(3), 5-39.

Solow, R. M. (1956). A contribution to the theory of economic growth. *The quarterly journal of economics*, *70*(1), 65-94.

Sani, I. A., Hassan, S., & Azam, M. (2016). Effects of exchange rate volatility on outputs in some selected West African countries. *International Journal of Development and Economic Sustainability*, *4*(1), 1-10.

Scott, A., Darko, E., Lemma, A., & Rud, J. P. (2014). How does electricity insecurity affect businesses in low and middle-income countries? *Shaping Policy for Development*, 1-80.

Sign, L. (2018). The potential of manufacturing and industrialization in Africa Trends, opportunities, and strategies. *Africa portal.*

Torres-reyna, O. (2007). *Panel Data Analysis Fixed and Random Effects longitudinal or cross- is a dataset in which the behavior of entities are observed across time. Princeton University*

Trotter, P. A., McManus, M. C., & Maconachie, R. (2017). Electricity planning and implementation in sub-Saharan Africa: A systematic review. *Renewable and Sustainable Energy Reviews*, *74*(December 2016), 1189–1209.

Ulaşan, B. (2015). Trade openness and economic growth : panel evidence Trade openness and economic growth : panel evidence. *Applied Economics Letters*, *22*(2), 163–167.

United Nations (2015) Sustainable Development Goals. Retrieved from https://www.undp.org/content/undp/en/home/sustainable-development-goals.html

Universit, I. A. L. E., Cuza, A. I., Ia, D. I. N., & Lv, T. (2008). the Relation Between Openness To Trade and Economic Growth. *Analele Ştiinţifice Ale Universităţii »Alexandru Ioan Cuza« din Iaşi. Ştiinţe Economice*, (55), 237–247.

Vaz, P. H., & Baer, W. (2014). Real Exchange Rate and Manufacturing Growth in Latin America. *Latin American Economic Review*, *23*(1), 2.

Wilson, M. K., & Bala, A. P. (2019). Regional integration and cross-border mergers and acquisitions in Africa. *Journal of Economic Integration*, *34*(1), 109-132.

Wooldridge. (2012). *Introductory Econometrics* (Fifth Edit; M. W. Sabatino, Joe, ed.). USA: South-Western 5191 Natorp Boulevard Mason, OH 45040 USA.

World Bank (2017) World Development Indicators. Retrieved from: https://datatopics.worldbank.org/world-development-indicators/world-development-indicators-reports.html

Zamir, M., Amin, A., Ullah, S., & Khan, S. U. (2017). *Exchange Rate Volatility in Pakistan and Its Impact on Selected Macro Economic Variables*. 167–187. *iBusiness*.

APPENDIX A

Hausman test for Table 9 (objective one)

Coefficients				
	(b) Fixed	(B) Random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
tdop	-0.1541246	-0.1544721	0.0003475	0.0016258
EXCFLU	0.0005437	0.0005576	-0.000014	0.0000166
inf	-0.0069935	-0.0068776	-0.0001159	0.000099
intrat	-0.005779	-0.0057499	-0.0000291	0.0000657
fdi	0.0000326	0.0000372	-4.64E-06	0.0000111
gcf	0.0078905	0.0087358	-0.0008454	0.0005743
lnecl	0.4966323	0.506882	-0.0102497	0.010376
wage	0.0048874	-0.0005312	0.0054187	0.0035544

Source: Ayirikame (2021).

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

Chi2(8) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 3.01

Prob>chi2 = 0.9335

APPENDIX B

Hausman test for the interactive term for Table 10 (objective two)

	Coefficients			
	(b) fixed	(B) Random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
tdop	-0.193384	-0.1889652	-0.0044188	0.0015101
EXCFLU	0.0005059	0.0005271	-0.0000212	5.08E-06
inf	-0.0078314	-0.0075909	-0.0002406	0.0001024
lms	-0.006097	-0.0060244	-0.0000726	.0000362
intrat	0.0000621	0.0000641	-2.05E-06	6.13e-06
fdi	0.0060553	0.0072858	-0.0012305	0.0006215
gcf	0.4906254	0.5029797	-0.0123543	0.0092062
lnecl	0.0096681	0.0026112	0.0070569	0.0037788
wage	0.0014146	0.0012362	0.0001784	0.0000789
ecltrad	-0.193384	-0.1889652	-0.0044188	0.0015101

Source: Ayirikame (2021).

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(9) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 0.73

Prob>chi2 = 0.9998

APPENDIX C

Hausman test for non-resource countries in table 13

	(b) Fixed	(B) random	(b-B) Difference	sqrt(diag(V_b S.E
tdop	-0.17745	-0.17638	-0.00107	0.00129
EXCFLU	0.000747	0.000756	-9.4E-06	0.000011
inf	-0.00703	-0.00693	-9.9E-05	8.09E-05
intrat	-0.00591	-0.00591	-5.2E-06	-
fdi	2.04E-05	1.43E-05	6.12E-06	-
gcf	0.003418	0.004045	-0.00063	0.00072
lnecl	0.457492	0.457353	0.000139	0.011222
wage	-0.00612	-0.00773	0.001605	0.004578

Source: Ayirikame (2021).

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(8) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 0.75

Prob>chi2 = 0.9994

(V_b-V_B is not positive definite)

APPENDIX D

Hausman test for non-oil exporter for table 14

	(b) Fixed	(B) random	(b-B) Difference	sqrt(diag(V_b S.E.
tdop	-0.13871	-0.13946	0.000753	0.001426
EXCFLU	0.000504	0.000512	-7.90E-06	1.26E-05
inf	-0.00621	-0.00616	-5.3E-05	0.000075
intrat	-0.00394	-0.00409	0.000156	0.000161
fdi	0.000606	0.000605	1.19E-06	1.71E-05
gcf	0.014933	0.015695	-0.00076	0.000524
lnecl	0.403512	0.410328	-0.00682	0.006942
wage	0.01758	0.013387	0.004194	0.002646

Source: Ayirikame (2021).

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(8) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 2.77

Prob>chi2 = 0.9479

APPENDIX E

Hausman test for an oil exporter for table 15

	(b) Fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E
tdop	-0.08364	-0.23335	0.149702	-
EXCFLU	0.001099	0.006613	-0.00551	-
inf	-0.00565	0.001416	-0.00707	-
intrat	-0.00505	-0.00853	0.003482	-
fdi	0.000154	0.000348	-0.00019	-
gcf	-0.01597	-0.02447	0.008508	-
lnecl	1.540839	-1.86134	3.402181	-
wage	-0.07237	-0.04749	-0.02489	0.023732

Source: Ayirikame (2021).

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(8) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 151.42

Prob>chi2 = 0.0000

(V_b-V_B is not positive definite)

APPENDIX F

List of SSA countries

Central Africa	Eastern Africa	Southern Africa	Western Africa
Angola	Burundi	Botswana	Benin
Cameroon	Comoros	South Africa	Burkina-Faso
The central African Republic		Eswatini	Cote D'lvoire
Dem. Republic of Congo	Kenya		The Gambia
Gabon	Malawi		Ghana
	Rwanda		Niger
	Tanzania		Nigeria
	Uganda		Senegal
	Zambia		

Source: Ayirikame (2021).

APPENDIX G

Sub-Saharan Africa: Member countries of groupings

None Resource Intensive	None Oil Exporter	Oil exporter
Benin	Benin	Angola
Burundi	Central Africa Republic	Cameroon
Comoros	Dem. Republic Congo	Gabon
Cote D'lvoire	Burundi	Nigeria
Eswatini	Comoros	Ghana
The Gambia	Kenya	
Kenya	Malawi	
Malawi	Rwanda	
Rwanda	Tanzania	
Senegal	Uganda	
Uganda	Zambia	
	Burkina Faso	
	Cote D'lvoire	
	The Gambia	
	Niger	
	Senegal	
	Botswana	
	South Africa	
	Eswatini	